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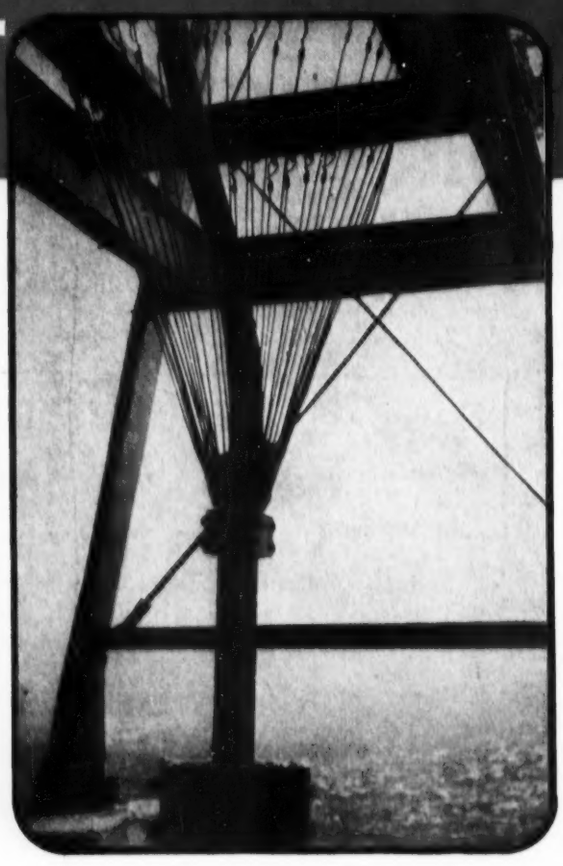

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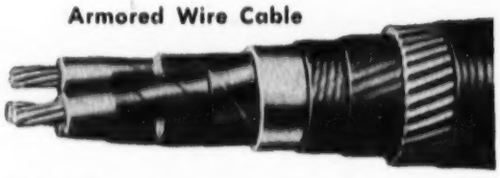

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April, 1946

Chance for an Efficient Interior Department

ALTHOUGH some people in the mining industry seem to have been disappointed when "Cap" Krug was chosen for Secretary of the Interior instead of some Western senator, we believe that it was a good appointment.

Krug is rated by some as a New Dealer; however, he is certainly not the starry-eyed kind. Neither is he the kind who would sell any principle down the river to buy a bloc of votes. He has held public office most of the time since leaving school—in the TVA, in the power branch of WPB, and, after a stretch in the Navy, as chairman of WPB. In all these places his record was good. He has displayed an uncommon ability to hold public office and make decisions on the basis of merit. He has not yet shown the typical tendency of public officeholders to be indifferent to efficiency and to weigh problems solely in terms of political consequences.

The Department of the Interior has been a politics-ridden institution for many years. With all Ickes' reputation for honesty and forthrightness, under him the department descended to new lows in political-mindedness and inefficiency.

The mining industry and the people of the United States can ask for nothing better than a Hercules with a will to clean up this Augean stable by putting it on a merit basis, ending double talk, and establishing policies based on straightforward thinking rather than political motives. We believe that "Cap" Krug is personally on the level, and likely to bestir himself to accomplish these objectives. On this basis we applaud his appointment to the Government department most concerned with mining and natural resources.

Minnesota Iron Mining Faces Important Changes

FOLLOWING HARD on the decade in which the iron-mining companies of the Lake Superior region have been cutting open-pit haulage costs and at the same time recovering ore tied up in track benches, by replacing locomotives and railroad cars with trucks and conveyors, the operators today appear to be facing a period in which there will be need of making further changes in mining practice, if important tonnages of ore are to be made available to the furnaces. The problem that now presents itself is that of lowering the cost of producing ore in the underground mines, either opened or still awaiting development, in order that the operator who has his own furnace may at least get a dollar back for a dollar spent or that the ores may compete the better with the more cheaply-mined open-pit ores. Some cheaper method of mining than the commonly used top-slicing method must be applied to the task of ore extraction.

Among the other items that enter into the ore production cost and that should be lowered is the burdensome taxation. The initial operating disadvantage of an underground mine, as compared with an open-pit operation, is accentuated by Minnesota's scheme of taxing ore in the ground annually, which tends to force the ore into production before its value is eaten up in taxes. Thus the more cheaply mined open-pit ore tends to get to the market first. Still another such item is the additional expense often entailed in meeting fee-owner requirements that are inadvisably severe. In such cases these requirements could be eased with benefit to both parties.

The effect of mounting production costs is shown in the steady decline in the number of operating underground mines in Minnesota from 80 in 1920 to 16 in 1946, as J. Fred Wolff, of the Oliver Iron Mining Co., points out in the article on page 70 of this issue. At the same time, according to Mr. Wolff, the proportion of Minnesota's iron reserves that has had to be mined by underground methods has been increasing at such a rate that it will be 50 percent by 1948, as compared with 38.5 percent in 1939. The situation he describes calls for remedial action by each of the parties concerned. A cheaper mining method, such as block-caving, which P. B. Bucky, professor of mining at Columbia University, discusses in an accompanying article, is part of the answer to the problem. The tax authorities and fee owners must cooperate.

Continued Exchange of Information Is Vital

IN CONTRAST to many manufacturers, most American mines, mills, and smelters always have pursued a more or less open-door policy in regard to plant and technical improvements. In view of the fact that manufacturers are confronted with a different kind of competition, this is quite understandable. The manufacturer is in active competition with others in the same business on both a price and quality basis. Consequently, it is quite natural for him not to divulge any process by which costs are lowered, as with lower costs he can reduce prices and obtain an increased share in the business. Also, if he has devised a process which improves the quality of his product, or its breadth of application in industry, he will want to retain this trade advantage by keeping his discoveries to himself. Though this policy may often be one of doubtful wisdom and at times difficult to carry out, he will follow it, nevertheless.

The metal producer, in contrast, has relatively little competition within his own industry. Custom mills and smelters competing for the same ore are, of course, in direct rivalry. Nevertheless, they are commonly quite generous in exchanging information.

Even when smelters compete for the same ore, a ready exchange of information will pay out in the long run. The consequent gains in efficiency will enlarge all the business done in a given area and extend the lives of the mines affected. The cut in this larger pie for each smelter will be greater than it is likely to enjoy at its competitors' expense if low efficiency keeps the pie small.

The real competition for the metal producer is with other products. The primary task of the metal producer, therefore, is to do all he can to reduce his general cost of production so that his product can compete successfully with other metals and materials. To this end, improvements in operating practice should readily be made known to others, visitors to plants made welcome, and descriptions published. By this interchange of information all will be helped and conditions in the industry itself improved.

Mining Wide Open to Communist Control

AT THE PRESENT WRITING, the last of March, labor relations in mining present a dismal picture. Most of the country's non-ferrous smelting facilities are strike-bound. Several of the important metal-mining districts of the West are similarly affected or threatened with shutdowns.

To the workman who has seen the auto, steel, and electrical workers get theirs, the problem probably seems simple enough. It's a matter of getting one's share of a pie being divided. Why not, when local authorities refuse to accord employers reasonable protection, when the Administration supports wage increases with phony surveys and "canned" fact finding, and when the Senate can still be trusted to squelch any legislation designed to curb the special privileges of labor organizations?

Recently we were given a shocking lesson in the irresponsibility of labor union leadership. Mr. Reuther, of the auto workers, callously stated that the whole subject of "a look at the books" was a mere propaganda campaign to get General Motors "over a barrel" with the public. Mr. Thomas, president of the union, affirmed that Ford and several other auto manufacturers had been "bargained" well beyond their capacity to pay!

Our industry might be able to consider the matter of being pushed beyond its means as a remote problem if there were assurance that metal mining unions have a more responsible attitude than the auto workers. However, recent events in the metal mining field are not reassuring. The demands being made are obviously excessive. In the Coeur d'Alenes, the union certainly regards the two-year contract signed last fall as a scrap of paper, as it is violating both its no-strike pledge and a guarantee to refrain from coercing non-union employees. At Park City, Utah, 80 miners struck for three days because a non-union watchman refused to contribute to a strike fund! At Holden, Wash., 300 miners struck for two days because certain drillers were not getting enough sugar! In the Tri-State district more than 300 employees of the Federal company struck because of the alleged discharge of a shop steward!

All these incidents force us reluctantly to the conclusion that we cannot count on metal-mining labor to refrain from pushing the domestic industry into a hole. Whatever the details may be, and whosoever's the blame, it is apparent that many employees in mining are ignorant of or misinformed about the industry's economic problems and their own stakes in maintaining the industry in healthy condition. We are not going to have sound labor relations unless constructive elements in the industry do a better job of educating the rank and file on these matters by honest analyses of mutual problems, answering in a constructive way the points that troublemakers raise. Such information should be non-technical and relate problems to the workman's own experiences. Preferably, it should be addressed to him at home, where he can study it without taunts or injury. Until mining labor understands its basic self interests better, we are wide open to Communist exploitation. Possibly we are already being exploited more than we realize.

Political Differences Over Fundamental Rights

Mr. Joseph M. Gambatese,
McGraw-Hill Washington Bureau,
Washington, D. C.

Dear Mr. Gambatese:

We find it difficult to understand why the politicians in Washington are hesitant about establishing in the labor field certain rights which are so deeply rooted in the American tradition that we cannot conceive why any right-minded people should oppose them.

As a recent example of political behavior, the Senate Committee on Education and Labor has thrown out of the Case Bill provisions for equal responsibility of both sides to observe contracts, and outlawing the shocking violence which is currently classed as "mass picketing."

We cannot understand how anyone interested in the success of collective bargaining can hold for one-sided observance of contracts. Neither can we understand why the United States Government condones the private use of force in preventing access of an owner to his property, or in cracking the skulls of people who do not string along with the violent element in a labor fight.

I am sure that our readers would be interested in your frank analysis of why the politicians act this way.

Very truly yours,
Evan Just

Dear Mr. Just:

Answering your inquiry, first let me explain that the Senate Committee on Education and Labor is weighted with legislators who are indulgent in regard to organized labor. Except for the wartime Smith-Connally Act, Washington observers cannot recall when the committee last reported out a bill containing any semblance of control over labor-management relations. The "Case bill," which ultimately did go through the committee, bore no resemblance whatever to the original. It was a complete substitute, shorn of practically all restrictions or compulsions on either side. Only the identification "H.R. 4908" remained of what the House had passed by the overwhelming vote of 258 to 155.

As a consequence, the committee has been regarded as the graveyard of any legislation which might even be suspected of regulating labor relations in any shape or form. It is agreed that even the Smith-Connally Act ultimately served as a shelter for strikes rather than the anti-strike law it was intended to be.

You ask specifically about provisions for equal responsibility under contract and for outlawing picket-line violence, which were plucked from the Case bill along with others.

The senators who voted to eliminate these provisions had their reasons for doing so. There are those who are beholden to organized labor, fear its political power, or simply want to take sides—labor's side. To some their survival in office depends on it, and they find many arguments to rationalize their position. They say:

Labor-management relations would be retarded rather than advanced; state and local laws are adequate; the Federal Government lacks a police force to enforce the law; injunctive procedures were abused by Federal courts in the past; employers even now can sue unions for violations of contract or fire employees; the National Labor Relations Board will not order reinstatement or back pay for any employee dismissed for violation of contract; a lawsuit-minded employer isn't going to get much peace in his plant (hardly any employers invoked the lawsuit privilege under the Smith-Connally Act).

Senator Tunnell (D.-Del.), committee member, summed it up: "It's just a lot of ballyhoo and propaganda. Everything they want is allowable in the (state and local) courts now."

The other side of the table sees this group of senators as just prejudiced in favor of unions.

"They're just opposed to any restrictions on unions," Senator Ball (R.-Minn.) told me. Senator Ball was one committee member who asked every labor leader or labor supporter who testified for suggestions as to how to correct labor abuses. He got none.

Senator Taft (R.-Ohio) pointed out that one of the committee even opposed a provision which would require collective bargaining on the part of the union!

You can see, then, why anyone in his right mind would hesitate to explain why people do certain things, especially senators. We will always have differences of opinion, even, to use your own words, in regard to "certain rights which are so deeply rooted in the American tradition that we cannot conceive why any right-minded people should oppose them."

Senators with the same objective may differ as to the means of achieving it, and vote differently. (I am not suggesting that the members of this committee have the same objective.) Everybody is in favor of preventing rampant inflation, but one group says this is done by lifting price control, and the Administration takes the opposite view. Legislators voting for the Smith-Connally Act thought they were voting to prevent strikes, whereas it developed that the law provoked more strikes.

Very sincerely yours,
Joseph M. Gambatese.

Underground Lake Iron Ore Costs Must Come Down

Remedy lies in improved mining methods, lower taxes, and less onerous requirements of fee-owners. Relief would be speeded by adequate upward revision of selling price.

J. FRED WOLFF, Mining Engineer, Oliver Iron Mining Co., Duluth, Minn.

ANY QUESTION as to the present status of underground mining in Minnesota and in the entire Lake Superior iron district is basically economic. The prime question is, can the mine operator get more than a new dollar for an old dollar invested? Can iron ore be produced by underground mining methods on a commercial basis under present and prospective future conditions of cost and selling price.

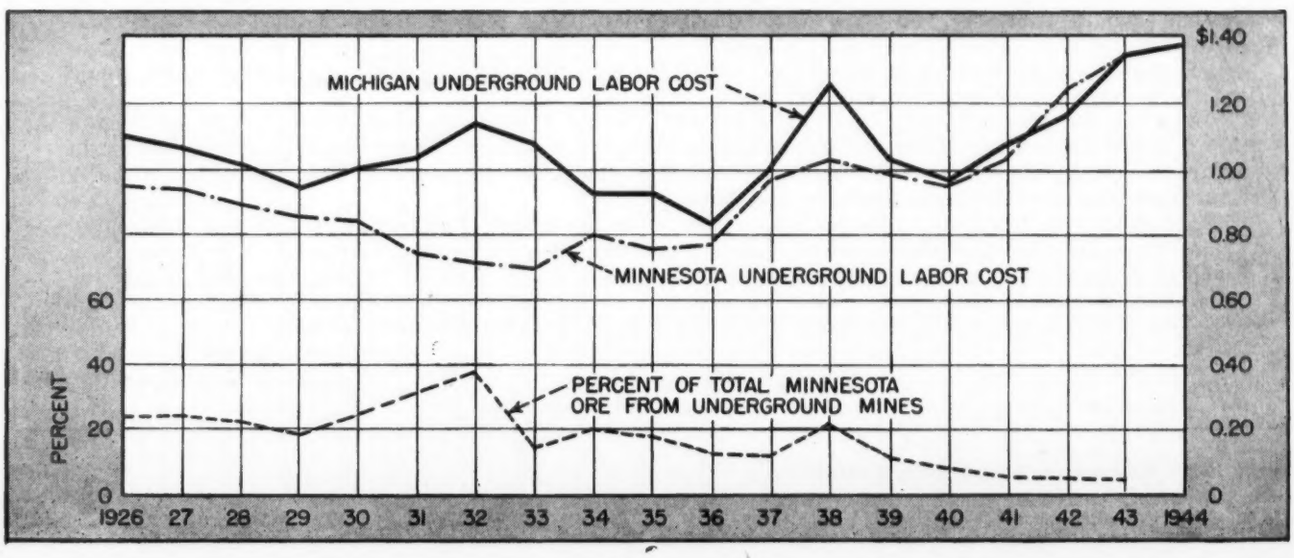
The number of underground iron mines has declined, largely because of high costs, at the same time that the proportion of Minnesota reserves that must be mined underground is increasing. In 1920 there were 80 underground operations in Minnesota. In 1929 there were 39, and in 1944 this had been reduced to 16, a reduction of 80 percent in 25 years. The reduction on the Mesabi Range alone has been from 59 to 9, or 85 percent.

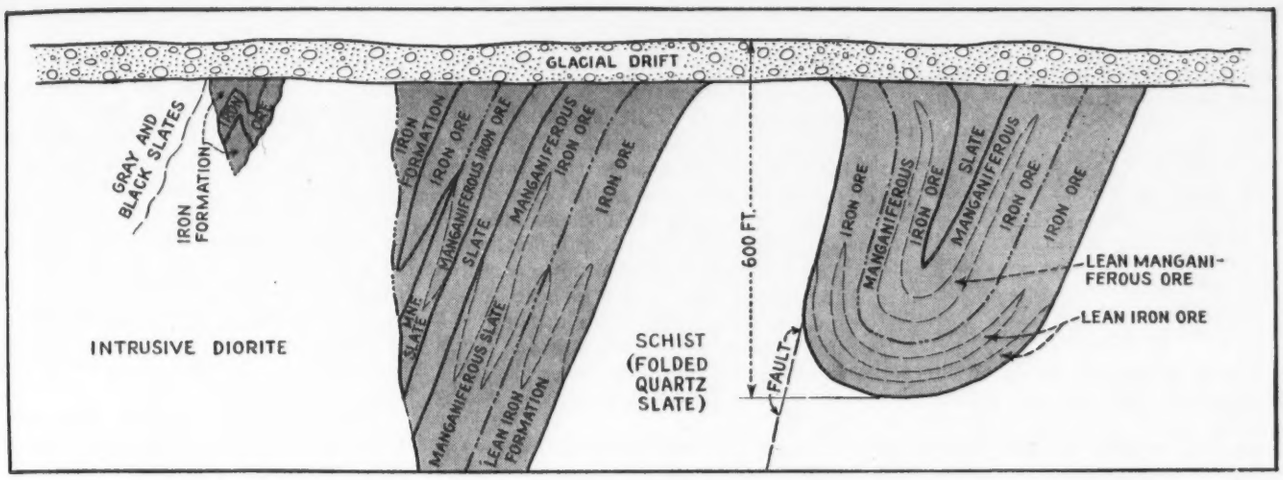
Some of this reduction is to be ascribed to exhaustion and conversion, in whole or part, of underground mines to open-pit operations, but the suspension of a large number of mines has been for commercial reasons, and their failure to reopen has been undesirable with respect to the public welfare.

As to the increasing proportion of Minnesota's iron ore reserves which must be mined underground, the State Tax Commission's reports showed 1,208,000 tons on May 1, 1939, of which 38.5 percent was classed as minable by underground methods. By 1944 the proportion had increased to 41.8 percent, and by Jan. 1, 1946, it was 46 percent, due to the extremely heavy draft on open-pit ores for war demands. With the expected demand of the next two years, the proportion will

From a paper presented at University of Minnesota Mining Symposium, Duluth, Jan 15-16, 1946.

LABOR COST PER TON of underground iron ore produced in Michigan taken from the Annual Reports of Michigan Department of Conservation, Geological Survey Division. Operating labor costs per ton of iron ore produced in Minnesota, exclusive of labor cost and development, beneficiation, and miscellaneous items, are taken from Biennial Reports of the Minnesota Department of Taxation. Percentage of Minnesota's total iron ore production that is derived from open-pit mines has exceeded 90 in recent years. Meanwhile the number of underground mines has decreased, until in 1944 it was 16, compared with 39 in 1929.





TYPICAL CROSS-SECTION of orebodies on Cuyuna Range, showing Iron Formation and geological associations.

be 50 percent by 1948; that is, half of the remaining Minnesota reserves of natural ores (excluding concentratable iron formation) must be mined by underground methods.

Twice in our lifetime Minnesota ores have underwritten the heavy demand arising from a major war. For the sake of national security, taxes and ore prices should be adjusted to enable the iron-mining industry to develop its underground ores as well as its concentratable iron formation, so as to extend as long as practicable the life of its rapidly minable, natural open-pit ores.

The people of Minnesota should realize that they are acting counter to the best national interest in imposing a heavy burden of taxes on the open-pit ores, thus forcing them on to the market to the exclusion of the underground ores which ought to be mined.

Varied Conditions

The two common types of orebodies on the Mesabi Range are the trough-shaped and the flat-layered bodies, the latter usually being the continuation down the dip or along the formation from a trough orebody. The Cuyuna Range underground orebodies have been chiefly concentrations in steeply dipping iron-formation layers, resulting in tabular orebodies. On the Vermilion Range, there are both trough and tabular orebodies of much greater depth than those of the Mesabi and Cuyuna Ranges. The Cuyuna has trough orebodies also, but most of them have been mined by open-pit methods.

The characteristics of the ore and the physical conditions of its occurrence have largely determined the mining methods which have been adopted, modified, and perfected. Safety and conservation have been controlling motives in the evolution of mining methods. At the same time, custom and inherited practice have determined the methods adopted in some places where a wider knowledge of more economical methods would have indicated the use of a different method for better commercial results.

Top Slicing Widely Used

The most widely applicable underground mining method in the Mesabi, Cuyuna, and, in part, the Vermilion Range mines is the top-slicing-caving system. There is need today to revise this procedure where physical conditions permit, to reduce costs to a permissible figure. Safety of life should properly be a first requisite of the mining method. Too much stress, however, has been put on getting 100 percent extraction for such a cheap commodity as iron ore, which is worth only 1/10 of a cent a pound at the mouth of the mine. In no other low-priced ore district in the world is such an effort made to recover 100 percent of the ore in the ground.

Sublevel caving has been used in two of the Vermilion Range mines, in one of them for several years, by necessity, to attain a permissible mining cost. There are several Lake Superior mines whose ores are smelted by related furnaces, which would have been closed down years ago if the mines had been independent and selling their ores in the open market.

The Soudan mine, on the Vermilion, uses a back-stoping method with filling because of its very hard ore and weak walls.

An accompanying diagram, prepared by A. E. Anderson, shows that from 1935 to 1943 labor costs alone for underground ore in Minnesota and Michigan increased from $0.78 and $0.85 to $1.35 per ton, or 60 percent. With the present trend there is no prospect that the labor cost per ton will decline appreciably if the underground mining methods now used are continued. Supply costs likewise cannot be expected to decline. The supply of suitable timber is becoming acutely restricted in Minnesota. Whereas in the 1942-43 season the Oliver Iron Mining Co. obtained only 9 percent of its company-produced timber for Minnesota mines from Michigan forests, the following season it had to take 36 percent from Michigan.

In both Michigan and Minnesota the records of the State Tax Commissions show the decline and vanishing of any profit margin in underground operations. The following tabulation from the published records of the Michigan Tax Commission shows the *theoretical* profits based on Lake Erie published ore-sale prices, not actual sales prices, which average substantially lower.

	Theoretical Profit	Tons Per Miner Per Day
1936	$0.484	8.55
1937	1.100	8.52
1938	0.323	7.32
1939	0.897	9.63
1940	0.748	7.36
1941	0.555	8.96
1942	0.387	8.52
1943	0.101	8.76
1944	0.003	8.41

Unfortunately, the Minnesota Tax Commission does not publish such complete average statistics of theoretical profits as does the Michigan Commission, but from the Mining Directory of Minnesota and the available public records of the reports to the Minnesota Commission I have been able to compile the following statement of approximate theoretical profits for the Minnesota underground mines, based on full Lake Erie published prices, not

the much lower prices at which at least some of the ore was sold.

1936	$....
1937	0.57
1938	0.03
1939	0.33
1940	0.22
1941	0.06
1942	0.15
1943	0.30
1944	0.54

For a group of seven of the ten Minnesota underground mines producing more than 2,000,000 tons in 1944, the reports to the Tax Commission show losses based on full Lake Erie prices ranging from 11c. to $2.26 per ton of production and averaging $1.01 per ton. Not even the lowest-cost producer showed a theoretical profit.

These facts plus the pressure on the market of heavily taxed open-pit ores indicate why underground mining has been declining. The mines which are operating are running largely to maintain communities, afford winter employment, and avoid ultimate losses which suspension of operations would entail. Obviously a combination of actions must be taken to permit profitable underground iron mining in the Lake Superior district.

A tabulation shows the burden of the State tax per ton of underground ore produced in Minnesota and Michigan for several years past, excluding corporate and social security taxes. The Michigan figures are exact and taken from published records; the Minnesota figures are approximate because two mines produce from both open-pit and underground.

Year	Minnesota	Michigan
1937	$0.380	$0.150
1938	0.541	0.322
1939	0.493	0.208
1940	0.388	0.153
1941	0.358	0.130
1942	0.310	0.113
1943	0.246	0.120
1944	0.292	0.152
Average	$0.368	$0.153

Inspection of these tax costs shows that Minnesota underground costs average two and a half times those in Michigan. Three-fourths of the total taxes are for the Vermilion Range mines, and the average tax cost for these mines, which are fairly similar in physical characteristics to many of the Michigan mines, is three times the taxes of the latter.

Regardless of the local mill rate of taxation in the different mining districts, practically all of the underground ore which is assessed on the old class-rate basis is greatly overvalued as measured by sound actuarial methods of determining value. Some of the class rates for underground ore are greater than the computed or actuarial valuations determined for some of the best open-pit orebodies, and to date the Minnesota Tax Commission has not corrected the error. One of the largest underground producing mines in the State has had a total tax burden for a number of years in excess of 75c. per ton of production, almost reaching $1 one year.

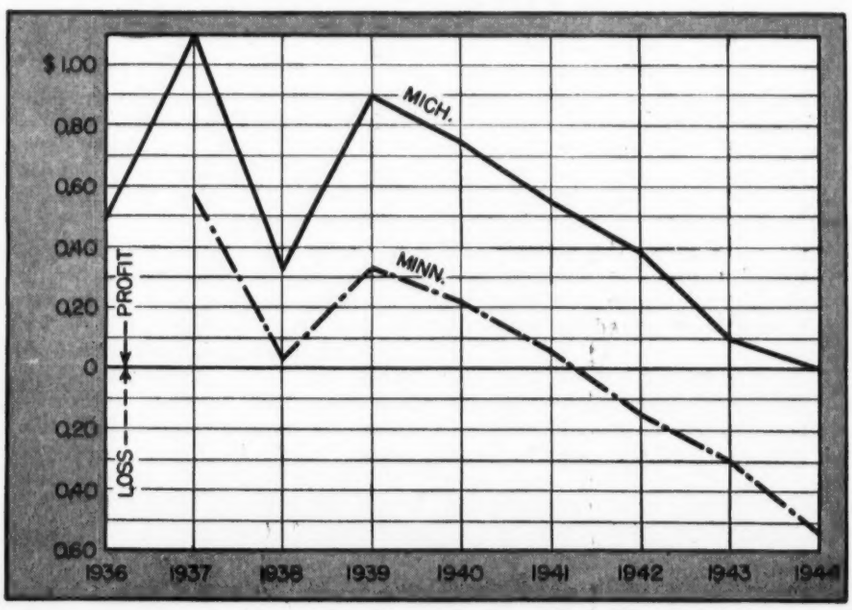
These tax loads are an important part of the reason why many underground leases have been surrendered, pending the time when competitive open-pit ore is not available for purchase. From a sound financial policy other leases probably should have been surrendered some years before they were.

The figures cited as to profit or loss in underground iron-ore mining indicate clearly that changes in the industry are called for promptly. One is a revision of mining methods where physical conditions permit. For years I have been convinced that sublevel caving or some adaptation of it should be applied wherever an orebody is thick enough. The resulting difference in cost is well illustrated in the two adjoining Vermilion Range mines where the costs of labor and supplies have recently differed as much as 90c. per ton, the top-slicing method being that much more expensive than the sublevel caving method. In most Mesabi flat-layered orebodies under the Lower Slaty horizon this method can well be applied where the ore is, say, 15 ft. thick, taking out 10 ft. on timber and drawing the back to the slate or paint-rock capping. The orebody should be well explored in advance by drilling, and main-level drifts should be driven in the taconite under the orebody, in which belt conveyors can be installed for transporting the ore. Shaker conveyors or perhaps motor transport such as is used in coal mines should be applicable on ore-producing levels to replace present scraping methods. Shaker conveyors are in use in one underground Mesabi mine now, and also in Michigan.

Some trough-shaped orebodies have a heavy rock-capping which may be ideally adapted to a block-caving method of mining. The top of the orebody should first be explored by sublevels and raises and possibly a top slice or two should be taken out, after which the main body of ore can be drawn through chutes on a main tramming or conveying level driven in the bottom rock. In many operations in Michigan and Vermilion orebodies, development main-level crosscuts must be in ore. The Montreal mine system may be applicable in several instances where the orebody is thick enough and has a rock capping. A room-and-pillar method might prove very usable under some circumstances, as in the 1890's in the old Fayal mine.

An underground milling method was used for many years in the Ely group of mines, and with proper modification for safety probably could have been continued. It was replaced by top slicing largely in the interest of safety, although the superintendent always maintained that if he owned the mine personally he would use the former method. Recent pyramiding of cost suggests that he may have been right.

THEORETICAL PROFIT or loss in operating underground mines in Michigan and Minnesota, based on data from State Tax Commission Reports.



The nearly exhausted main orebody in the Leonidas mine, at Eveleth, under a heavy rock capping, would have been ideal for block-caving or for a room-and-pillar system after taking off a slice or two at top and at either side to insure getting the top ore cleanly.

A sand-filling method used in some German coal mines which are situated under inhabited areas might have application in some Iron Country orebodies. With it the orebody is mined from the bottom up. It was considered to be favorable by some American engineers prior to the war.

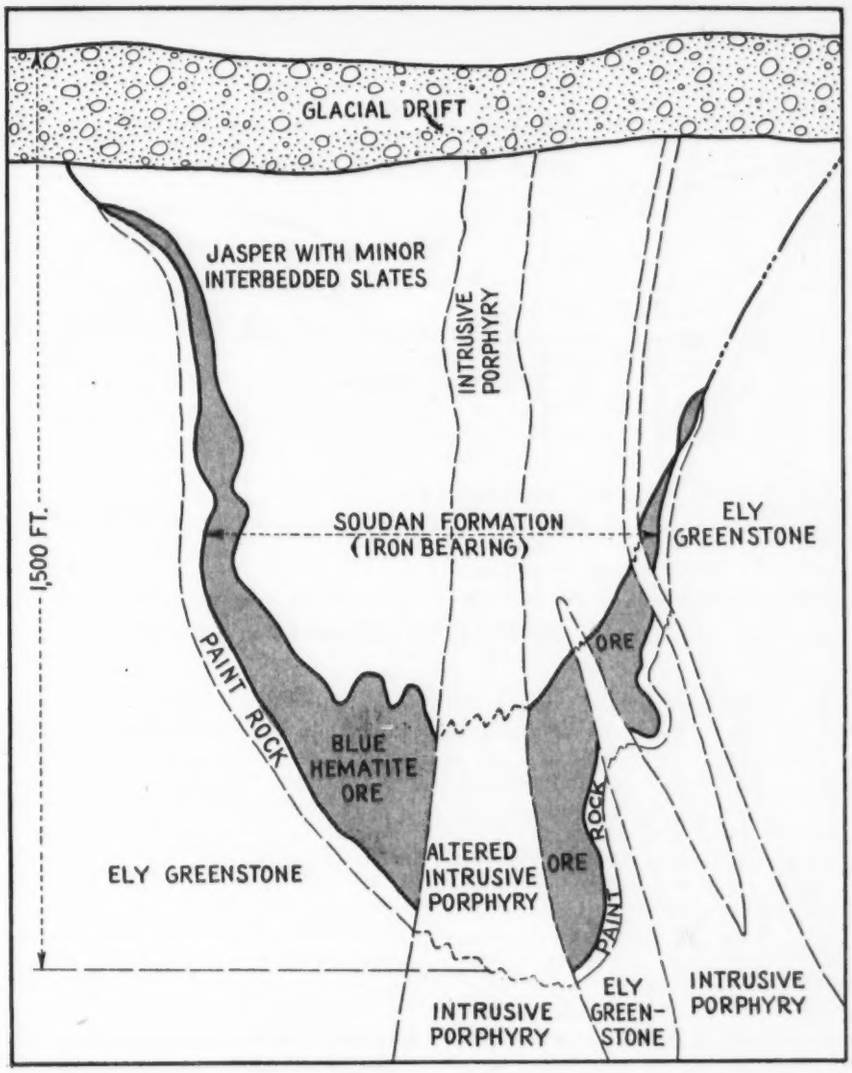
Shrinkage stoping may be applicable in certain deep, tabular orebodies if the walls are strong enough.

Revisions of mining methods must be effected if costs are to be reduced sufficiently. Some improvement may be made in top slicing, but the outlook for a continuance of high labor costs, and the scarcity and cost of suitable timber for Minnesota mines do not promise sufficient cost reduction with this mining method alone.

Fee-Owner Should Help

None of us who have been associated with the iron-mining industry since the early development of the system of inspection by fee-owners' agents will deny that for several of the early years the system was a salutary influence toward efficiency and clean mining. It kept mine management on its toes. Since then, the mine organizations themselves have kept so efficient that they have not needed the early watchfulness.

A tradition has grown up, however, of mining all soft ore material down to 49 or 50 percent dry iron. In some operations this has had undesirable results. All leases call for mining "merchantable ore," and by common consent, supported by court decision, "merchantable ore" is ore which, as it exists in the ground without mixture with other ores, can, when met in course of mining, be mined, shipped, and sold at a profit or at least without financial loss. Now most, if not all, ores analyzing only 49 to 50 percent dry iron cannot be mined by underground methods without loss. And it has been proved that any mixture of unprofitable with profitable ore results in a final net loss. I have in mind two recent operations in which the practice of taking such low-grade material has resulted in so lowering the quality of the total output that in one mine certain areas have had to be abandoned and in the other the mine has been closed down.



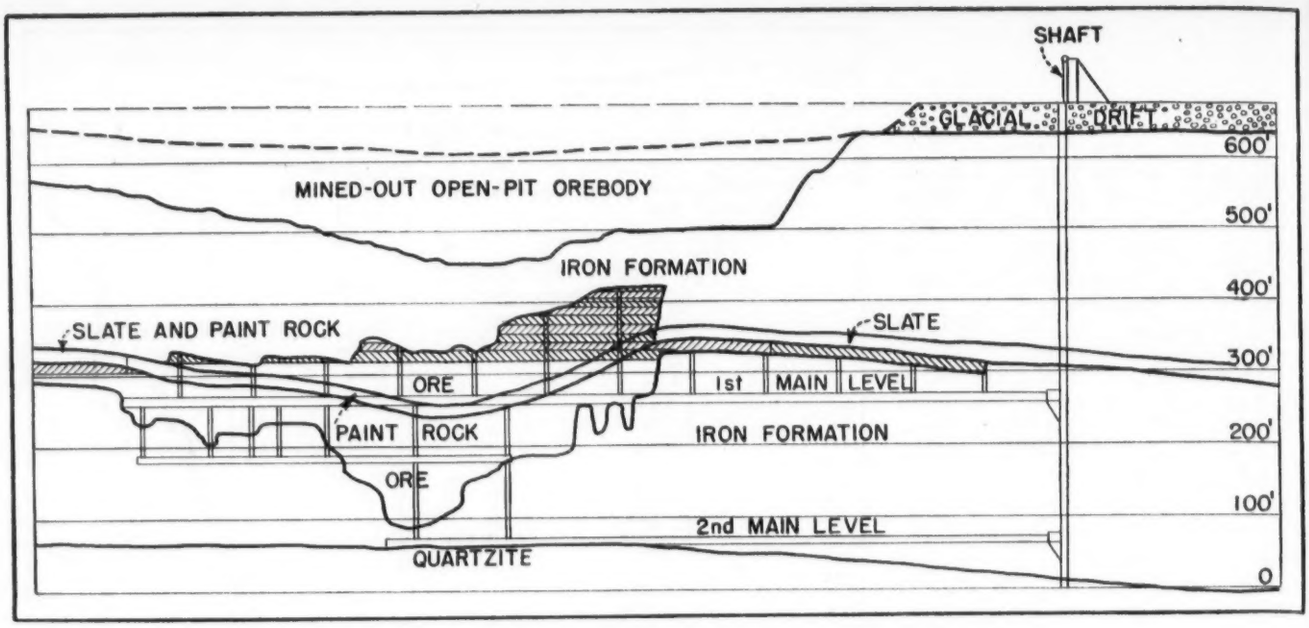
CROSS-SECTION OF TYPICAL OREBODY on Vermilion Range in northern Minnesota, showing relation to the Soudan Iron Formation.

The practice of forcing operators to follow out a thin wedge of ore on the bottom or in fissures regardless of cost or quality should be modified, or applied with broad good judgment, to promote rather than to restrict underground mining. Operators accede to the urgings of fee-owners' agents in following a line of least resistance and preventing complaints to higher executives. Rarely does either fee-agent or mine captain know whether the ore in question—if marginal—is merchantable. Management should provide operators with financial information complete enough to enable them to determine merchantability of ores.

Fee-owners' agents can contribute much to a mutually advantageous solution of the problem of mining ores that can be concentrated where they are associated with merchantable ores, rather than to have to leave them in the ground and possibly lose some of them entirely.

The question whether a mining method other than top-slicing will recover 100 percent of the orebody is naturally of concern to the fee-agent. Whatever dilution may come with other mining methods will replace any ore which might be lost. Moreover, the operators have a larger stake in the maximum recovery than the owners have, because the former have made all the investment in the mine and the ore is worth more to them in finished product than it is to the fee-owner. Therefore, they will get the maximum commercially allowable recovery. If there is much dilution by any cheaper mining method, an ore-treatment plant on surface may be required, and the saving in mining cost must be sufficient to more than offset such treatment cost or the lowered value of the vitiated ore quality.

The fee-owners' agent should keep in mind the desirability of promoting underground production, because the rate of income and consequent present worth of his royalties is far more important to his principal than is 100 percent recovery. A casual study, or even an inspection, of com-



CROSS-SECTION of Mesabi Range orebody mined by underground method.

pound interest or discount tables will furnish much food for thought to the fee-agent. For example, if a mine has a 40-year life and produces in equal average annual amounts, 80 percent of the present worth of the fee-owner's income will be received in the first 20 years of half of the mine's life, using 8 to 3 percent discount rates to determine present worth. From this comes the importance to the owner of early maximum production from his property rather than of waiting for subquality ores to become merchantable or forcing dilution of presently merchantable ores.

Production costs should be reduced if the proposal just made—namely, to revise mining method, to curtail taxes, and to relax the pressure on operators to mine non-merchantable ore—are ultimately put into effect, but the process would be a slow one. The facts cited as to present losses on underground operations in both Minnesota and Michigan, and the prospect for continued high costs, call for an upward revision of the Lake Erie selling price for iron ores. It is a matter of record that the mining companies did request federal approval of higher prices during the war period, but that OPA refused to grant it, largely because the great tonnage of open-pit ore was being produced at an adequate profit. It failed to recognize the unfavorable position of the underground producers. All are familiar with the meager advances of 10 and 20c. per ton for Mesabi and Old Range ores permitted Dec. 29 last by OPA, belatedly and insufficiently recognizing the unfavorable position of the underground mines.

To determine what is the proper price for Lake Superior iron ores other than that determined by competitive sales always has been difficult because of many commercial factors involved. These ores are in competition with iron ore from every other producing area in the world.

We all know that the principal competitor of iron metal is scrap metal, 45 percent of American steel being made from purchased scrap. An exhaustive study made more than 10 years ago showed that over long terms of years the Lake Erie ore price gave Lake ores a little advantage over scrap at the average prices at which the latter was available. This situation is hardly true now.

Low Prices for Competition

The depression of Lake ore prices has resulted from competition of more cheaply minable open-pit ore seeking a market before the burden of taxes could eat up all their expected margin of profit. This has been a distinct handicap to the underground ores.

I submit the following as a measuring stick for the sales price of Lake ores. Shipments from the Michigan mines are a substantial part of the entire Lake Superior output, ranging from 17 to 25 percent during the past 10 years. Some of these ores are quite indispensable in the present technique of the American steel industry, though they might be replaced. The mines from which they come represent very large investments, and upon them are dependent several important communities and a large population. I propose as an economically sound thesis that the price of iron ore should be such that the Michigan orebodies containing marketable ores and without extraordinarily expensive physical conditions can be mined to yield a modest but reasonable profit on the necessary capital.

The problem is to arrive at some precise figure. In 1944, as cited, the average Michigan underground ores were mined without profit, assuming that the full theoretical Lake Erie prices, averaging $4.62 per ton, were received for them. The 1945 ores probably were mined at a loss, except for the recently allowed increase of 20c. per ton, and many of the 1944 mines, especially on the Gogebic Range, must have operated at a loss. The average loss on the Vermilion Range mines has been much more than on the Michigan mines because of the heavy burden of Minnesota taxes, which have averaged much more than the royalties received.

Considering the hazards and uncertainties of underground mining, in order to return a reasonable profit on the investment and assure the return of the latter, I submit that the 1945 price for iron ore should have been increased a minimum of about 10 percent, or, say, 50c. per ton, to be adjusted upward if labor and supply costs continued their recent ascending trend. Even this increase will not bring the average Vermilion Range production out of the red. However, revision of mining methods should improve the situation.

Such an improvement in ore prices and the adoption of revised and cheaper mining methods where physically possible, plus reasonable cooperation from taxing authorities and fee-owners' agents, should do much to stimulate underground mining in Minnesota and increase and stabilize employment.

Lowering Mining Costs With Block-Caving

PHILIP B. BUCKY, Professor of Mining, Columbia University, and Consulting Engineer

Where applicable, this method of mining can be expected to give excellent results in respect to tonnage broken daily. There are doubtless many places where its possibilities could well be considered.

IN 1898, at a meeting of the Lake Superior Mining Institute, E. F. Brown informed the membership that, at the Pewabic mine, on the Menominee Range, in Michigan, the company had been mining large blocks of strong iron ore for the previous three years by a procedure which made use of the earth's available forces for crushing the ore to a size suitable for handling. At that time he was making available to the profession the concept of block-caving and the results of the first successful full-scale caving experiments.

Since that year we have seen these concepts play an important part in the development of underground mining methods. They are responsible for the creation of our largest underground mining properties, and for the development of practices having considerable effect on other mining methods. They have made possible the mining of low-grade orebodies previously considered unworkable, and have reduced underground mining costs to the point at which they are in serious competition with those of open-pit mining. It is a far cry from the Pewabic mine, which in 1898 produced about 200,000 tons per year, to the present-day operations at Climax, Inspiration, and Miami, which now produce at a rate of 14,000 to 20,000 tons a day, or from 5,000,000 to 6,000,000 yearly.

At present the best block-caving mines have a production rate of more than 32 tons per man-day, a figure considerably in excess of that obtained with most underground methods.

The concept previously held that block-caving mines must have large outputs to be efficient has been shattered by the showing of the Crestmore limestone mine. Between 1941 and December 1945 this mine had no lost-time or fatal accidents and produced at the rate of 32 tons plus per man-day, with a daily output of less than 1,000 tons.

Lest one get the impression that all block-caving properties produce at such a high rate, the following estimates are given:

Forty-eight percent of the block-caving tonnage is at a rate of 20 tons plus or minus per man-day.

Twenty-eight percent of the block-caving tonnage is at a rate of 20 tons plus or minus per man-day.

Ten percent of the block-caving tonnage is produced at a rate of 17.5 tons per man-day.

Fourteen percent of the block-caving tonnage is produced at a rate of 12 tons plus per man-day.

Another mining method having considerable possibilities is longhole drilling, sometimes known as forced caving. The best production record in this field according to present data is 19 tons per man-day. We may look for continuous improvement and advances in both methods.

Block-caving methods of mining may be described as those procedures for mining orebodies which utilize the earth's barodynamic or gravitational forces to stress portions thereof, when and as desired, so that

A paper presented at the University of Minnesota Mining Symposium, Duluth, Jan. 15-16, 1946.

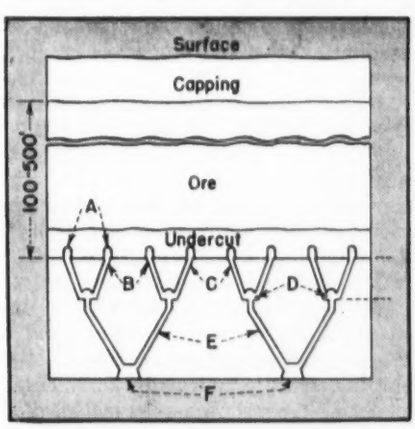


FIG. 1. Generalized vertical section of stope block prepared for caving. A, Undercut drifts. B, Draw points. C, Finger raises. D, Grizzly drifts. E, Transfer raises. F, Haulage drifts.

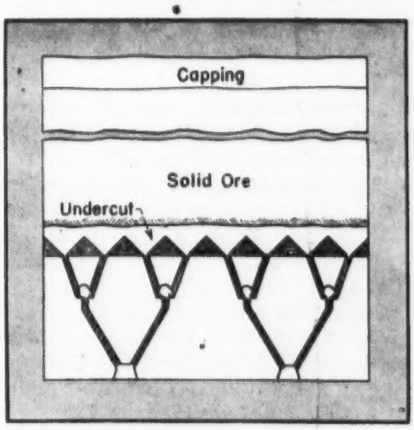


FIG. 2. Here the block in Fig. 1 is seen a short time after the undercut has been made and some of the fragmented ore has been drawn through finger and transfer raises.

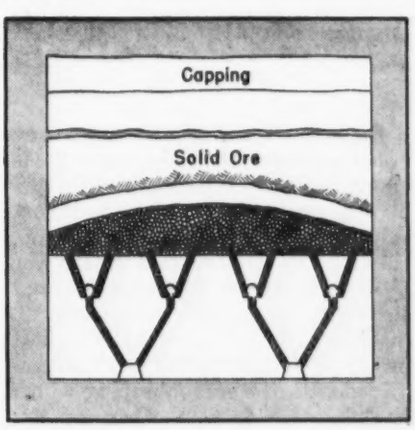


FIG. 3. As caving progresses in the block shown in Figs. 1 and 2, the ore is drawn off to provide a void under the free face. Ore continues to spall off or cave to this void.

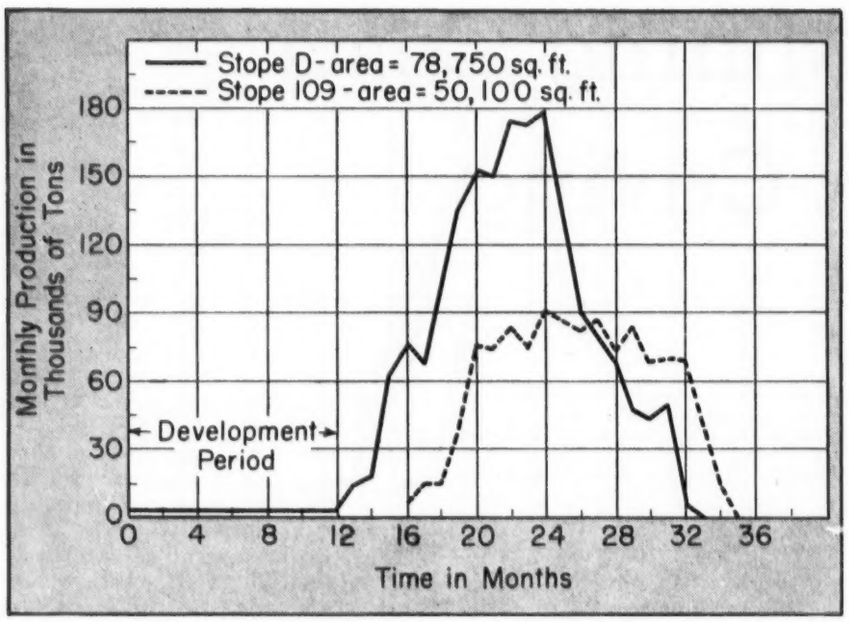


FIG. 4. Block production-time curve for one of Miami Copper's stopes.

these portions produce ore fragments of a size suitable for handling. In addition, they provide a means for further fragmentation of large pieces of ore, and a transportation or transfer system that economically transports the ore to the shaft bottom.

The earliest block-caving procedure, that described by Mr. Brown as taking place at the Pewabic mine, on the Menominee Range, in the Michigan Iron Country, was as follows: A block of ore 200 to 250 ft. along the strike, as wide as the orebody, which varied in this respect up to 200 ft., and of a height of 100 ft., was prepared as follows: Two parallel open stopes 8 ft. wide, one being at each end of the block, so that they were 200 to 250 ft. apart, were driven at right angles to the strike from hanging wall to footwall and to within 20 ft. of the level above, or to the capping. The bottom of the block was then undercut to a height of 7 ft. on the haulage level. This resulted in a block of ore that was free on the bottom and on the ends. The forces acting on the block were those due to its own weight, to that of the capping above it, and the side thrust between the hanging wall and the footwall. It took several weeks for the bottom of the block to fail and fill the undercut with caved material. The block, however, was left alone for six to eight months, which coincided with the season during which the lake was frozen, when no ore could be transported. During this period it was reasoned that the forces acting on the material would crush it. When drawing commenced, 80 percent of the material passed through a 3-in. ring.

After the ore was sufficiently crushed, in the opinion of the management, timbered crosscuts were driven by spiling from the haulage drift in the footwall to the hanging wall. From these, additional spiled drifts were driven on 25-ft. centers to the end of the caved ore. Plats were placed at the ends of these drifts and the ore was allowed to run in. The ore was then shoveled into cars until waste appeared. When this happened a set or two of timbers were blasted down and drawing was resumed.

Inducing Caving

Present-day block-caving procedures use two methods for inducing caving action in a block. These may be described as:

1. The method using the earth forces surrounding a block to cave it, and

2. The Crestmore method, whereby the forces made available by the block itself are used to cave it.

The first method is illustrated in Figs. 1, 2, and 3, and is used at the Inspiration, Miami, Ray, Johnson, King, Sunrise, and Climax properties.

Fig. 1 shows the following features of a block-caving stope: (1) A block of solid ore 100 to 500 ft. in height, 100 to 800 ft. in length, and 85 to 200 ft. in width. (2) Development work on the undercut level comprising a series of openings from which the undercut is drilled and blasted. This undercut may be 7 to 20 ft. or more high and etxends over the block area. (3) An ore-transfer system, consisting of draw points (here defined as the intersection of the finger raises with the undercut level), finger raises, a grizzly level, and transfer chutes or raises, which system carries the ore from the stope to the main haulage level, where it is loaded into cars. The course of the ore flow is through the draw points and the fingers to the grizzly level. Here it is processed or broken into fragments by sledging, or by drilling and blasting, so that it may readily pass through the transfer chutes or raises and be loaded into cars.

Fig. 2 shows the block a short time after an undercut has been made and the fragmented undercut material drawn.

An explanation of what happens when caving action in a block takes place is afforded by Fig. 3. The material spalls, or caves off the bottom of the block, increases in volume, and fills the void made by the undercut. Continued drawing of this broken ore provides a void under the block, and a free face on the bottom surface of the block from which the ore may continue to cave. This action is continued until the cave reaches the surface. Further drawing of the ore causes the surface to subside.

Under the Crestmore method, whereby the forces made available by the block itself are used to stress and cave, the block is completely freed from contact with the laterally surrounding material by opening shrinkage stopes around the periphery of the block.

The undercut is made progressively in a direction across the block. After this has proceeded a certain distance, the portion of the block overlying the undercut is a partial cantilever in which shear, tensile, and compressive stresses are induced. This results in spalling or caving at the bottom of the block within.

Ore is drawn until there is just enough of the caved material left to support the block where undercut. The cut is continued across with similar effects. Drawing thereafter depends on the judgment of the men in charge.

It is evident that with a complete understanding of the methods of inducing stresses in an orebody and a knowledge of their effects, the mining possibilities would be enormous. At present our knowledge of this subject is decidedly limited. It should not be, for the tools with which a better understanding may be had are available. They are baro-

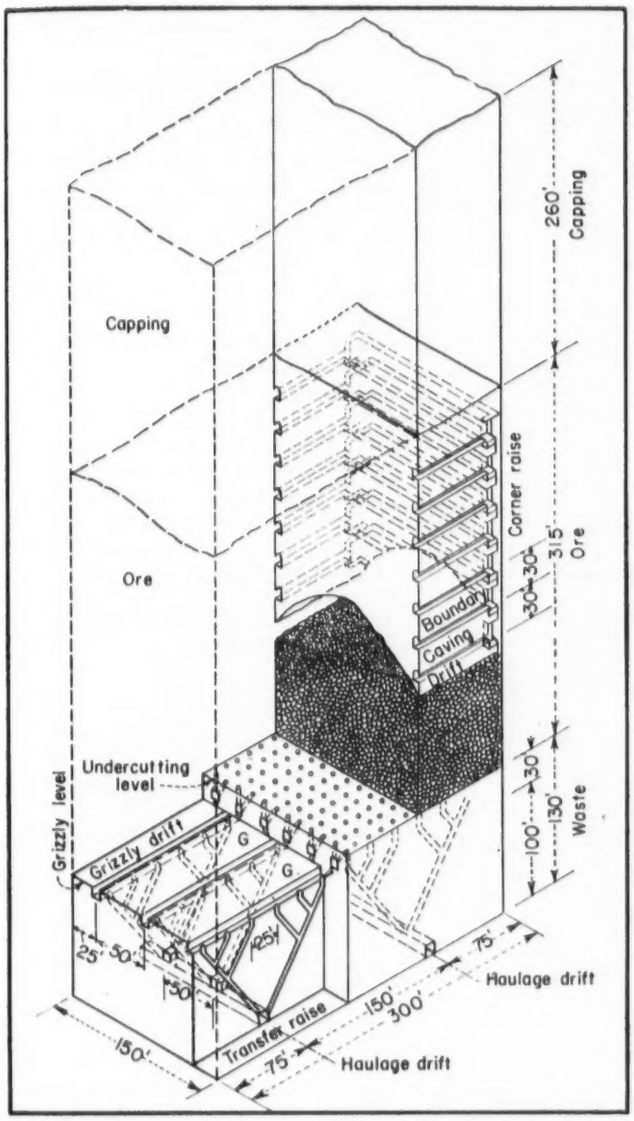


FIG. 5. This drawing of an intermediate block-caving procedure at Inspiration, which is no longer used there, demonstrates use of corner raises and fringe drifts.

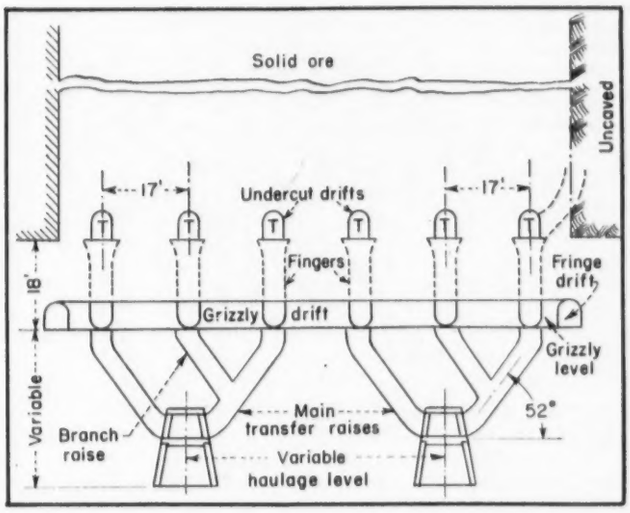


FIG. 6. Transfer system, as at Miami and Inspiration, using long and narrow fingers for small particles. Compare this type with larger fingers used at Crestmore, shown below.

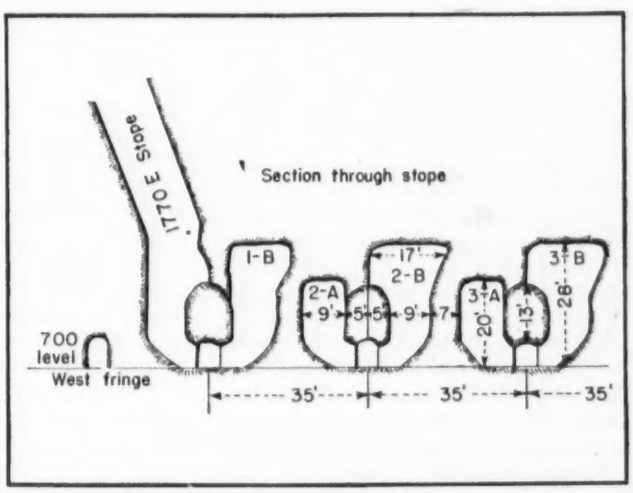


FIG. 7. Where particles are larger, the fingers are shaped as at Crestmore, here shown. Each finger serves approximately 940 sq.ft. of stope area.

dynamic centrifuges, photoelastic apparatus, and the mathematical and physical sciences. All that is necessary for a better understanding is the encouragement of research and work in this field.

When to bring a block into production is demonstrated by the block production-time curve for Miami shown in Fig. 4. Data for a small and a large block are shown. The solid line refers to a block about 150x525 ft. in size, or somewhat less than two acres, and the dotted line to a block 150x330 ft. in dimensions, or somewhat more than one acre. The time within which to complete the development work is shown as 12 months. Maximum production for the large block is 180,000 tons per month, or 7,400 tons per day, and that for the small block is shown as 90,000 tons per month, or 3,700 tons per day. Concentration of production in such small areas makes it easier to supervise the workings adequately.

A similar production-time curve for Inspiration, which is adjacent to Miami and working the same orebody, with blocks 100x100 ft. in lateral dimensions, indicates a development period of three months and a maximum monthly production per block of 30,000 tons, or 1,230 tons plus per day.

A drawing efficiency chart is available at the Anaconda offices for each block at Inspiration, Anaconda's subsidiary. The orebody has been thoroughly drilled and assayed and the tonnage and value of each block are known. Data collected at the mine are used to check the figures. The tonnages extracted and the ore values agree closely. Efficiencies run over 100 percent, because some capping containing ore is being drawn. Thus it is seen that high production rates and high ore-extraction efficiencies are being obtained with these methods.

Changes in Practice

Changes in block-caving practice may be listed under the following headings: (1) The Block Itself. (2) The Undercut. (3) The Transfer System. (4) Method of Handling Broken Material. (5) Block-drawing Procedures.

Block Dimensions. The original blocks at the Pewabic mine were 200x250 ft. laterally and 100 ft. high. At present, maximum block lateral dimensions are 270x300 ft. at Crestmore and 150x800 ft. at Miami. The maximum height of block now

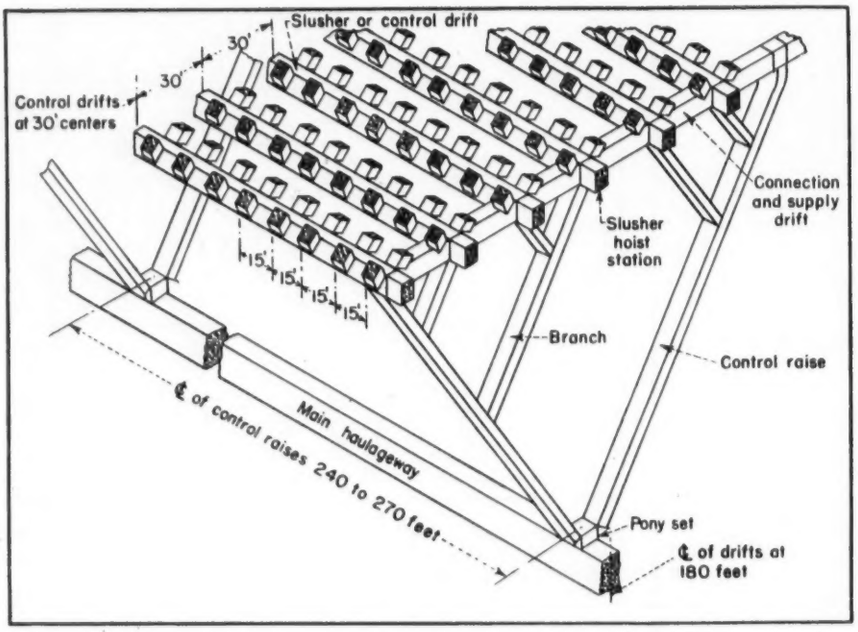


FIG. 8. Transfer system for orebodies of minimum thickness.

being caved at Climax, Johnson, and King is 500 ft.

At Pewabic the development work for caving consisted of an undercut and two stopes, one at each end of the block. The practice first adopted at Inspiration and Miami (Fig. 5) included a series of raises, one in each corner of the block, and a series of fringe or boundary caving drifts 4x6± ft. in cross-section, at 30- to 40-ft. vertical intervals around the block. The purposes of these raises and drifts were variously described, such as to prospect the block further, weaken the walls where they were considered too strong, and to control the caving area.

The procedure described is not now used at Miami or Inspiration, and has been replaced by that shown in Figs. 1 to 3. Johnson and King, however, still use fringe drifts and corner raises.

The Undercut. There are a variety of methods of making an undercut.[1] They all serve the same purpose, that of providing an open face for the ore to cave to. The essential differences in making the undercut are those where (1) the open span under the block is increased gradually by pillar shooting, or (2) where all pillars are shot at once.

King uses method (1), and Johnson uses method (2). Inasmuch as these mines are alongside each other and work the same asbestos orebody by practically the same methods, their results are interesting. If there is any difference in the quality of the fragmentation due to the method of blasting the undercut, I have been unable to observe it. All other properties use the method whereby the open span under the block is increased gradually by pillar shooting.

The Transfer System. The shape of the undercut in the vicinity of the fingers and draw points is of considerable importance, especially if the fragment or particle size is large.

For fine or small particles the fingers may be long and narrow, as at Miami and Inspiration (Fig. 6). Where the particles are larger, they are shaped as at King and Crestmore (Fig. 7).

The area of stope served per finger or per draw point varies considerably, with a tendency to increase draw point and finger spacing or both. The finger spacing at Pewabic originally provided 25 sq.ft. of stope area per draw point. Sunrise, Miami, and Inspiration, with weak ore, or ore in which good fragmentation is obtained, average 312 sq.ft. King and Johnson, with ore that breaks in large sizes, average 533 sq.ft. Crestmore, with strong ore that breaks coarse, averages 940 sq.ft. Climax, with coarse ore, uses 1,750 sq.ft. per finger or draw point in its slushing drifts, and 2,500 sq.ft. where a grizzly is employed.

Determination of the proper draw point or finger spacing is an important item in development costs and in determining percentage extraction. It was discussed in considerable detail in an article entitled "What Is the Proper Draw-Point Spacing for Block-caving?" in the June 1943 *Engineering and Mining Journal.*

Where the ore breaks fine, a transfer system, consisting of a number of inclined chutes spaced at regular intervals for delivery to a pony set and car, works well and is economical if the orebody is thick enough and can stand the development expense. If the ore is less than 130 ft. thick, shaker conveyors or scrapers are used to eliminate all the transfer raises except one at each end of the block, between the grizzly and haulage levels.

In handling particles of large size, it is necessary to reduce them, by drilling and blasting, to a size which will not clog the transfer raises. Climax has solved this problem by providing a means for handling large particles and eliminating the transfer raises. Material from the fingers is bulldozed to a size the scraper can handle in the slushing drift. The slushing drift is at right angles to the haulage drift and sufficiently above it to allow the scraper to load a train of cars on the haulage drift. The efficiency of the system is attested to by the fact that the men in the slusher drift produce at the rate of 350 tons per man-shift. When one considers that this material is very coarse, and that men working on similar materials that must pass through grizzlies produce 82 tons per man-shift, their accomplishments can be realized. As a further comparison, with mines where the caved ore runs like sand, the tonnage per man-day through grizzlies varies between 200 and 280.

Drawing Procedure. The drawing procedure in block-caving consists of two phases: (1) that type of drawing necessary to produce proper fragmentation in the block, and (2) the drawing after a block has been completely caved or fragmented. The amount of draw in blocks in all mines except Crestmore during the caving stage should be just sufficient to allow a minimum free space between the broken ore and the uncaved. Too much draw will allow either caved material from the sides to come in or will create a spalling tendency from the ribs of uncaved ore. After a block has completely caved to the surface, experiments and field results indicate that drawing may continue at an accelerated rate and without much regard to either the position of draw or the amount drawn.

Experimental work described in the article previously cited has been done on asbestos ore followed by fine mill tailings, and has been verified

[1] See "Mining by Block Caving." By P. B. Bucky. Published by Hercules Powder Co., Wilmington, Del.

by the drawing practice at the King mine, where drawing is done to meet tonnage and grade requirements. The results have also been verified by model tests and practice at Ray. The reader is cautioned, however, that the experimental results apply to asbestos ore and tails only, and that these conclusions should not be applied to other ores or conditions without model tests.

Block-Caving Fundamentals

To break any material the following are essential:

1. A free face to break to.
2. Forces to act on the material of such a magnitude as will induce in the material stresses which will cause failure.
3. Time for the material to fail.

If one examines a block preparatory to caving, it is seen that a free face is provided after the undercut is made and drawn. The forces acting on the block to induce caving are the side forces as shown. These may be shown to be equal to $\frac{P_1 u}{1-u}$ where P_1 is the weight of material between a certain point on the earth's surface and the mine working elevation, and u is Poisson's ratio for the material. If u is taken as $\frac{1}{3}$, $\frac{P_1 u}{1-u} = \frac{P_1}{2}$. It may be shown that a compressive force, $\frac{P_1}{2}$, results in a shear stress equal to $\frac{P_1}{4}$. If $\frac{P_1}{4}$ is greater than the shear strength of the material at its weakest points or planes, the material will fail at these planes, and the distance between planes will give an approximation of the size that the material will cave to. The size that material caves to varies from that of fine-running sand at Miami, Inspiration, and Sunrise to boulders of 10 to 50 ft. at Climax, Johnson, King, and Crestmore.

To determine whether an orebody will block-cave we should know:

1. The physical characteristics of the ore.
2. Physical characteristics of the materials in the orebody that may be present in its planes of weakness.
3. The approximate distribution of the planes of weakness.

These data may be determined from samples and laboratory tests. They imply the determination of the tensile, compressive, and shear strengths, and the moduli of elasticity of the material in the orebody and in its planes of weakness.

In addition, it is essential to determine (4) the forces available to act on the block and the stresses they will induce. These may be determined from a study of the geologic structure, sometimes comprising a large area; the use of physical constants applicable to the rock in this area; and the application of fundamental mathematical and physical principles.

If an orebody is so situated that the earth's forces are sufficient to induce rupture shear stresses in it, and if the planes of weakness are close enough to provide good fragmentation, it will block-cave.

Caving at the Crestmore

The Crestmore is a strong, bedded limestone deposit, and is so situated that the earth's forces are insufficient to cause fragmentation or even failure when 200x200-ft. openings were made under the block.

The method used provides a means of obtaining fragmentation in blocks with certain characteristics, without the aid of the earth's forces surrounding the block. Fragmentation in this case is obtained by the proper utilization of the forces or weight in the block itself to help break it.

The procedure, imperfectly understood at present, is described as follows:

1. A block is cut free on all sides by shrinkage stopes, thus freeing it from the action or effect of the surrounding earth forces.

2. An undercut then retreats across the block, causing the beds in the blocks to separate and act as cantilevers. With cantilever beds, considerable stresses in tension-compression, and shear, are induced, and fracture points in the beds are obtained at close intervals as the cut moves across. The spalled or caved material is then only partly drawn, to induce failure in the overlying rock beds when and as desired. To those with experience in longwall coal mining or in top-slicing it may be described as retreating in such amounts, and for such heights of cut, as will induce breaks at the closest spacing possible. The breaking of overlying beds may be obtained by a retreat caused by drawing caved material.

Block-caving as practised today has resulted from the application of a considerable number of cut-and-try methods in the field, and from model experiments. The outstanding published example is that of Lehman, at Inspiration. It has not been successful in some mines and has been superseded by other methods.

One hears little about block-caving failures unless one digs patiently to get the facts. However, it is a method of mining whose qualifying elements for success can be fairly well determined by careful testing and experiment. It is reasonable to believe that the 32 tons per man-day figure may be increased to 50 or 60 tons per man-shift, with the attaining of more knowledge as to how to handle larger particles underground. The solution of this problem concerns itself with the determination of the laws of flow of loose materials in fingers and raises; the determination of a number for the flow of loose material, similar to the Reynolds number for liquids; the determination of the shape and manner of making the undercut; and the determination of new procedures for inducing stresses in orebodies.

The era is at hand, from a mining standpoint, when a knowledge of the physical properties of the orebody and the surrounding material will have as much effect on the economic working of the orebody as a knowledge of its ore values.

For Iron Country Ores?

Whether present-day block-caving methods can be applied to the ores of the Iron Country, so as to provide lower costs and greater safety, is a question which can be answered only after a careful study and tests of the geological material comprising the property in question have been made. In 1898 Brown proved that it could be done at the Pewabic mine, on the Menominee Range. In the copper country of Arizona these methods have been used successfully for mining copper ores running less than 1 percent (20 lb. per ton). Climax is mining a fraction of 1 percent of MoS_2 and Crestmore is mining limestone by this method for use in cement making. All the properties mentioned have low-grade ores. It may interest Iron Country operators to know that ore worth approximately $1 a ton may be mined profitably by these methods, for the direct cost for block-caving in the most efficient mines, with labor at $8 per day, is considerably under 60c. a ton. Direct costs include all items except interest, depreciation, amortization, home office, selling expense, and taxes.

Foreign Mining Investments Require Government Support

CHARLES WILL WRIGHT, Washington, D. C.

INDUSTRIAL WELFARE in the United States will depend in the foreseeable future upon an adequate supply of minerals obtained both domestically and abroad. The extent to which we are or will be dependent on foreign imports is a matter of considerable controversy. It is clear that early action is essential if we are to maintain from foreign sources the flow of minerals required by American industry. This calls for a constructive plan of American participation in developing and operating foreign mines through cooperative agreements with the mine owners. If our industrialists hesitate to act, other countries will acquire control of these foreign sources, and we will then be dependent on the whims and foreign policies of other nations for the mineral products essential to maintain our industrial and military position. However, before risking capital investment in foreign countries, the American mining companies should be assured of Government protection against unjust legislation imposed by foreign governments. Given assurance of such Government support, our mining companies will feel justified in undertaking the development of mines and plant construction in those countries where an adequate return for such risks is recognized to be equitable and essential.

As will be pointed out, the opportunities for rehabilitating old mines and developing new ones in the foreign field are many and are waiting for American interests to participate in their exploitation. Some foreign governments oppose the old system wherein American companies acquired a 100 percent interest in a property. They overlook the fact that in the past they got, and are still getting, great benefits from the mines which have been developed by American companies. It is these countries which are now demanding that not more than one-half of the shares, and in some instances less, in a newly formed mining company or syndicate may be owned by a foreign company. A third or half interest, however, is better than no interest, and with proper guarantees this part interest may prove more satisfactory than a controlling interest. Managerial contracts between the mine owners and American or British companies in which the latter have only a 20 or 30 percent participation are giving satisfactory results in certain countries. With equitable treatment, foreign mining investments by Americans through cooperative agreements would be beneficial to all concerned. They should also be a help toward better mutual understanding and thus should contribute toward international trade backed by good will.

Action Necessary

The mineral industries are of paramount importance in international relations. International organizations play an important part in controlling the prices, the production, and the movement of products such as diamonds, petroleum, tin, and mercury, and the success of mineral industries within a country may be dependent on relations with these international groups. However, competition exists for the acquisition of important sources of mineral products by private industry, and during the period of reconstruction, particularly in the Eastern Hemisphere, the owners of properties producing such minerals will deal directly with private industry when arranging for their exploitation. The interest in the United States in such foreign mineral sources is definitely linked with the efforts and actions of American industrialists who have acquired or are ready to acquire interests in foreign mining companies or combines. Such organizations have been the object of much discussion at the United Nations conferences in Washington, San Francisco, Mexico City, and London. Many wise and timely resolutions have been approved to promote mineral production and trade, but no action has been taken.

Charles Will Wright

Production and trade in mineral products, including the precious metals, depends on private initiative and its success depends on a free flow from source to consumer. If this flow is handicapped by trade barriers, exchange restrictions, and high taxes, as is the situation in many countries, their mineral industries go into reverse, to the detriment of all.

In the January issue of *Engineering and Mining Journal*, the resolutions adopted at the Inter-American Conference held in Mexico City in March 1945 are discussed in detail by Howland Bancroft. Resolution No. 50 sets forth the principle that "it is of mutual interest for industrialized countries and those not yet industrialized to develop soundly based industries in the latter" . . . by lending "to one another the maximum amount of technical and financial cooperation and to agree upon certain basic principles which will guide their conduct in the attainment of this laudable common purpose." Resolution No. 51 proposes "a constructive basis for the sound economic development of the Americas through the development of natural resources; increased industrialization; improvement of transportation; modernization of agricul-

ture; development of power facilities and public works; *the encouragement of investment of private capital, managerial capacity, and technical skills*; and the improvement of labor standards and working conditions, including collective bargaining, all leading to a rising level of living and increased consumption." In conclusion, Mr. Bancroft states, "If such remedial actions are taken as have been so clearly outlined and recommended in the foregoing, most of the uncertainties and risks of investments in the further development of Latin-American mineral deposits will have been eliminated, and the proposed ventures can be judged solely on their merits as commercial enterprises."

Another outstanding article, which proposes a policy to be followed by the Department of State, is that of Dr. C. K. Leith, published in the January 1946 issue of *Mining and Metallurgy*. It discusses our foreign mineral policy, including tariffs and exchange barriers, international cartels, production, price and market controls, and the problem of conservation.

Just how or by whom such positive action is to be taken and made effective needs immediate and constructive thinking and encouragement, not only by our statesmen and industrialists, but by those of foreign countries. Published articles, speeches, conferences, and the preparation of projects by government officials are meaningless if divorced from action. We can be assured of quick and positive action only through private enterprise. Thus, the present situation calls for our Government to encourage and protect the American mining companies and industrialists who are willing to take the risk of developing mines and mineral deposits in foreign countries. In the past American industrialists have been the pioneers in foreign countries in building up new industries which have helped solve economic and unemployment problems in these countries.

International Policy

It would be dangerous for us to depend solely on domestic production of materials which are in short supply, hoping that foreign countries will step in and aid us in the event of future war emergency. The time to insure accessibility to such supplies is when the countries producing them need economic aid. Our capital and management will provide the best insurance for making such materials available in time of need. Wherever American companies can handle both management and distribution of strategic materials, a true measure of security is available.

To stimulate action, it is suggested that American industrial groups and the labor unions advise members of Congress, as well as the Department of State, of the urgent need for the establishment of a constructive international mineral policy. This should be so framed as to give encouragement to the American mining companies willing to risk investing their capital in the exploitation of foreign mines and mineral deposits, in order to assure that American industry will obtain at least some of these essential mineral products at a reasonable price. Labor is necessarily just as much interested as the industrialist in the problem of getting from foreign sources the minerals we will eventually need to maintain our competitive position on world markets for finished products.

Nationalization Versus Progress

In most foreign countries, the trend appears to be stronger than ever toward nationalization of mineral resources. These countries have exploited most of their high-grade deposits, but in the field of marginal deposits they have not had the capital nor the technical experience to carry out large-scale mining operations successfully. This is particularly true of the precious-metal deposits, the exploitation of which would be an important factor in supplying exchange to improve trade balances. Nevertheless, these governments believe that they should have a larger share in the profits derived from foreign-controlled operations within their borders. To meet this situation certain American companies are ready to cooperate with the local owners of mines and mineral deposits by taking managerial contracts, not only for one property, but for a number of properties, under cooperative agreements, supplying the capital, machinery, sales agencies, and the "know-how," without control, or at most with a 50 percent interest. Such arrangements are favored by the mine owners as well as by most of the foreign governments. These American interests also believe that by sharing the profits from their operations with the local interested parties, they will be protected against unjust taxation or confiscation.

Foreign nations will doubtless wish to solve their domestic problems themselves without interference. However, the mine owner needs assistance in rehabilitating and developing his mine, such as facilitating the acquisition and delivery of supplies and equipment and making arrangements for long-term contracts for his products, to warrant capital expenditures for mine development and plant expansion and assure continuity of employment. Such factors should have a favorable influence on the attitude of a nation towards trade barriers, taxes, labor problems, prices, and markets.

Our Machinery Needed

During the past ten years I have been fortunate in making surveys in foreign countries for the Bureau of Mines in cooperation with the Foreign Service officers of the State Department. Surveys have been made in almost all the European and Latin American countries, and I have recently returned from a six-month resurvey of the mining industries in Europe. My talks with the mine operators, the department of mines' officials, and other holders of public office in many countries clearly indicated that most of the mine owners would welcome our "know-how" in their mining operations. They need our modern machinery to increase mineral recovery and reduce costs. They also want us to take a financial interest in their companies as a guarantee of efficient management. They realize that our methods are better, and that their local engineers, in certain large-scale operations, are lacking in experience. Such participation, naturally, involves a certain risk because of local mining laws and the difficulty of withdrawing dividends. However, I was assured that cooperative arrangements could usually be made with the local governments to overcome such financial restrictions, particularly with those countries which want our help. It is necessary, of course, to make such arrangements before American companies conclude investment or managerial contracts.

This situation abroad has been discussed with certain of the larger American mining company officials and, although interested, they hesitate to take any action unless the State Department (1) is willing to protect them against unjust actions on the part of the foreign government, (2) will facilitate the travel of their mining engineers sent to examine the properties, and (3) will instruct the mineral and commercial attachés to help them in their study of the local mining laws, labor con-

(*Continued on page* 154)

Bunker Hill Plant Recovers Metallic Cadmium From Fume

JOHN B. HUTTL, Associate Editor

CADMIUM CONTENT of Bunker Hill lead receipts is very low, assaying at best around 0.05 percent. During the past ten years the cadmium content of incoming ores and concentrates has been from 6 to 8 tons per month, and prior to 1939, cadmium fume concentrated at the smelter was shipped for treatment to an electrolytic plant operated by the Sullivan Mining Co. (jointly owned by Bunker Hill & Sullivan Mining & Concentrating Co. and Hecla Mining Co., and operated in conjunction with the Sullivan electrolytic zinc plant), two miles from the Bunker Hill smelter at Kellogg, Idaho. Owing to increased cadmium byproducts from expanded zinc operations after 1939, the Sullivan plant was unable to handle the cadmium products from both operations. Although small tonnages had been marketed periodically, the smelter had accumulated considerable cadmium in the form of concentrated fume by 1944, and to expedite marketing this metal, plans were developed for a plant capable of producing 1,000 lb. of metallic cadmium per day.

A combined leach and retorting process was selected after five years' experimental work on practically all known processes. Construction of a plant was started in 1944, and production of metallic cadmium started in June, 1945. Direct distillation of smelter fume was tried with success, but was not adopted because it is inflexible, being limited to material of high cadmium concentration (not less than 40 percent) and low arsenic content.

Fume Concentration

As cadmium fume concentration is related to the process, at the smelter, it is of interest. Cadmium content of the smelter receipts is very low, and were it not for the marked tendency of cadmium to volatilize during routine lead smelting, such small metal concentrations would be lost continuously in the large tonnages of blast-furnace slag and other smelter products. Yet, the ready volatility of cadmium and its compounds at prevailing lead smelting temperatures results in its concentration in fractional portions of fume collected, which comprise a continuous circulating load in the smelter system. Thus, the cadmium content of the fume increases with each successive circulation until it reaches an equilibrium value which is attained in a given system when the sum of the losses in slag, waste gases, and other end products becomes equal to the cadmium intake as ore and concentrates.

In Bunker Hill lead smelting operations, a concentration of 3 percent cadmium in the circulating baghouse fume is readily obtained. Beyond this point, the concentration gain per cycle becomes progressively less, reaching a minimum when the fume attains a maximum cadmium content of from 8 to 10 percent. Therefore, to avoid excessive loss, baghouse fume attaining a content of 3 to 4 percent cadmium is removed from the regular lead smelting circuit for special concentration treatment.

Cadmium concentration procedure consists of fusion of the baghouse fume with siliceous flux in a reverberatory furnace. During fusion the bulk of the cadmium is vented as a volatile oxide, and the lead retained is tapped as a silicate slag, which is either returned direct to the blast furnace or stored for antimonial lead operations. The cadmium fume is collected in a separate baghouse section. In this manner, fume charged to the reverberatory furnace at 3 to 4 percent, in a single cycle, may be readily concentrated to a grade approaching 27 percent cadmium. Attainment of cadmium fume of higher concentration (40 percent plus cadmium) requires reverberatory feed ranging from 11 to 15 percent cadmium. In recent operations, higher reverberatory furnace feed has been obtained either by utilizing fume collected during periodic antimonial campaigns (wherein unusually high proportions of cadmium-bearing materials enter the furnace charge), or by recirculation of 27 percent cadmium fume with variable portions of low-grade cadmium fume. Though the new cadmium plant was designed for the treatment of fume of lower

CADMIUM SPONGE from precipitation tank and pulp from leach tank are treated in alternate batches by this 42-frame Shriver press. See flowsheet on opposite page.

grade, excess capacity has been maintained to date by the processing of fume of the following average grade: Cd, 44.5 percent; Pb, 20.2 percent; As, 5.6 percent; Sb, 2.1 percent; Zn, 1.6 percent; S as SO_4, 3.2 percent; S, 3.4 percent; Cu, 0.05 percent; Fe, 0.15 percent; insoluble, 0.9 percent; and silver, 2.7 oz. per ton.

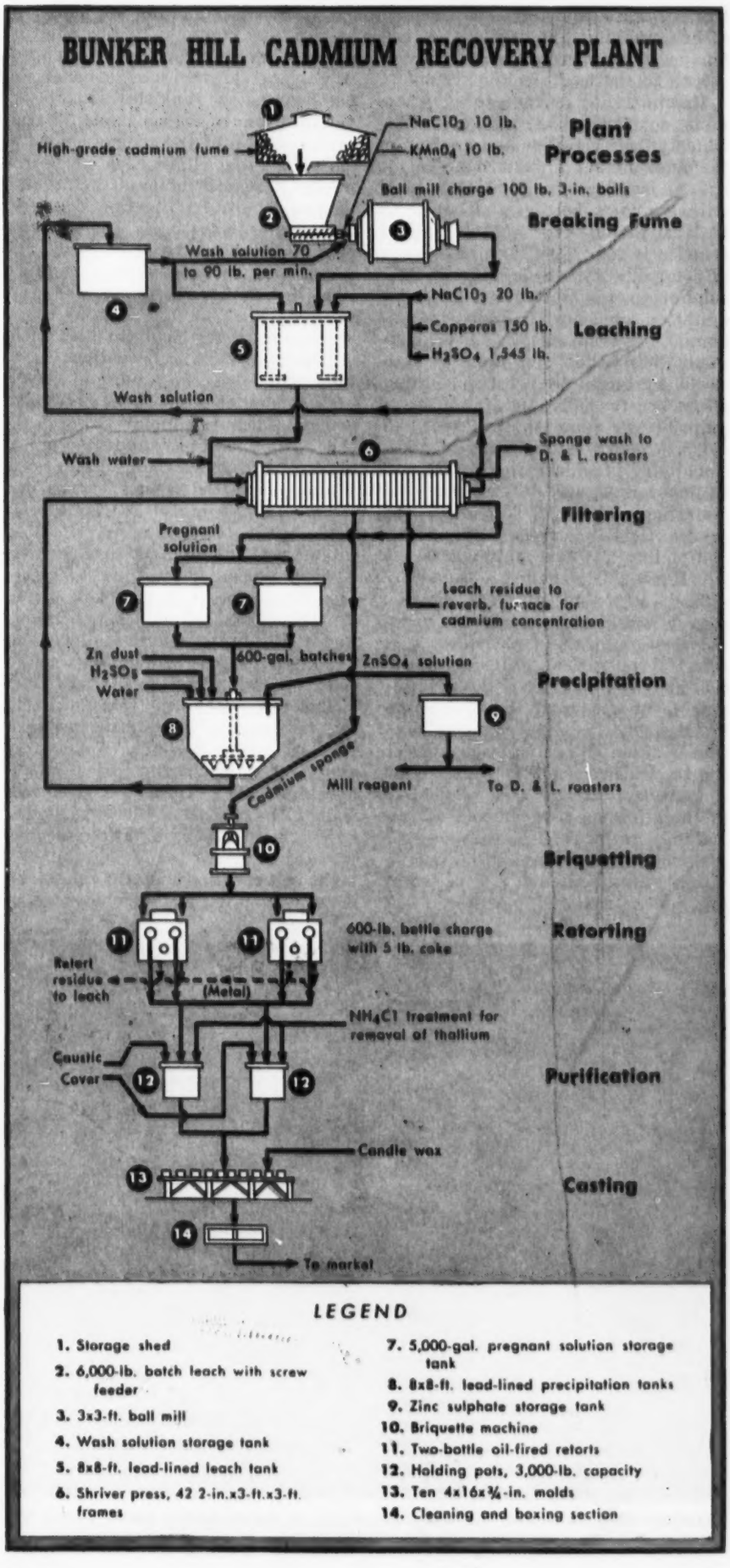
The new plant, constructed under the direction of the company's engineering and research departments, is compact and fireproof. Machinery is placed to afford safe operation and easy access for repairs. Many units are controlled by automatic devices. All floor wash water, spills, and leakage from the Shriver press drain into a central sump for subsequent pumping to the D. & L. roasters. The 24-hr. operation of the plant requires 13 men, with 5 men employed on the day shift and 4 men each on the remaining shifts. On Sunday only the retorts, with one attendant per shift, are operated.

Cadmium Recovery

The following major operations are carried out in the plant: (1) breaking or mulling cadmium fume in a small ball mill, and subsequent leaching of the resultant pulp; (2) precipitation of pregnant solution; (3) briquetting and retorting precipitate; and (4) casting molten metal into bars. See plant flowsheet.

At the start of ball-mill operations, water in the amount of 70 to 90 lb. per min. and $NaClO_3$ (10 lb. per 6,000-lb. batch) are added, with 10 lb. of $KMnO_4$ being fed to the mill during the period when the last 100 lb. of the 6,000-lb. batch leaves the feed hopper. Prior to starting up the ball mill, the lead-lined 8x8-ft. leaching tank equipped with a special agitating mechanism is filled with about 300 gal. of wash water, followed by addition of 150 lb. copperas, 1,545 lb. sulphuric acid, and 20 lb. $NaClO_3$. When this has been completed, the ball mill is placed in operation and a 2-hr. period is required to charge the leaching tank to 1,800 gal. volume. The leach slurry is then tested for pH, with extra pulp being added if the pH is below 5.5. As soon as the pH has been set at 5.5, the charge is agitated for 1 hr., and resultant pregnant solution checked for arsenic content. If the reading is above 0.005 g/l arsenic, permanganate is added in proportion to the amount of arsenic in solution.

Next, the leached pulp is pumped to a Shriver press. The pregnant solution, containing about 140 g/l cadmium and 0.005 g/l arsenic, goes to one of two lead-lined 5,000-gal.



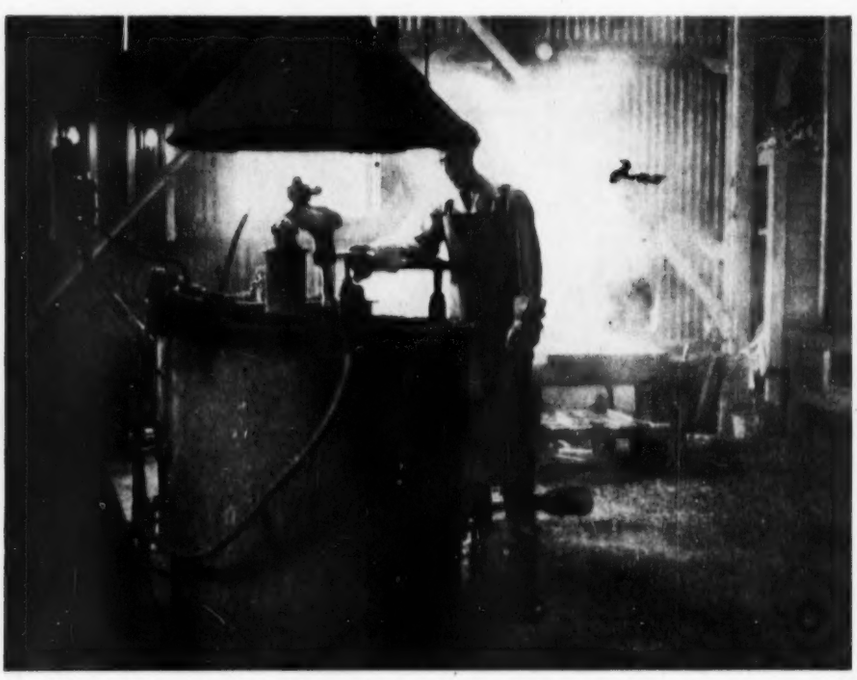
storage tanks, and the leach residue, after washing and blowing, is dumped to a concrete storage bin for return to the lead smelter system.

Precipitation of the stored pregnant solution is a key operation which affects recovery and quality of the final metal. This is done in an 8x8-ft. lead-lined precipitation tank with a conical bottom and equipped with a turbine-type agitator. The solution is fed to the tank in batches of 600 gal. and is made up to 5½ g/l sulphuric acid. With the solution in agitation, zinc dust is added in proportion of 1 lb. zinc to 1.6 lb. cadmium in solution. At the end of a ½-hr. agitation period the solution is checked for cadmium. If the assay indicates cadmium in excess of 0.5 g/l, a proportionate weight of additional zinc is added. During the entire operation cycle, to avoid the precipitation of basic sulphates, the solution acidity is frequently checked and maintained at a minimum of 2.5 g/l H_2SO_4. The sulphate salts are difficult to wash from the metallic sponge and greatly reduce the metal recovery obtained in the subsequent retorting operation. After precipitation has been completed, the agitator unit is stopped and the sponge allowed to settle. Zinc sulphate solution is decanted to a storage tank as shown, whence some is sent to the concentrator for use as a reagent in the flotation department, and the remainder to the D. & L. roasters. To the sponge remaining in the precipitation tank about 600 gal. of water are added, followed by 10 min. of agitation and simultaneous pumping of the tank contents to the Shriver press. The agitator unit is stopped when most of the sponge has been pumped and the tank sluiced by hose. Decantation of zinc sulphate and tank washing of the sponge enable a more effective elimination of detrimental sulphate than can be accomplished by direct filtration followed by washing in the press. About eight precipitations are required to fill the press, and between each precipitation the sponge is given a direct wash.

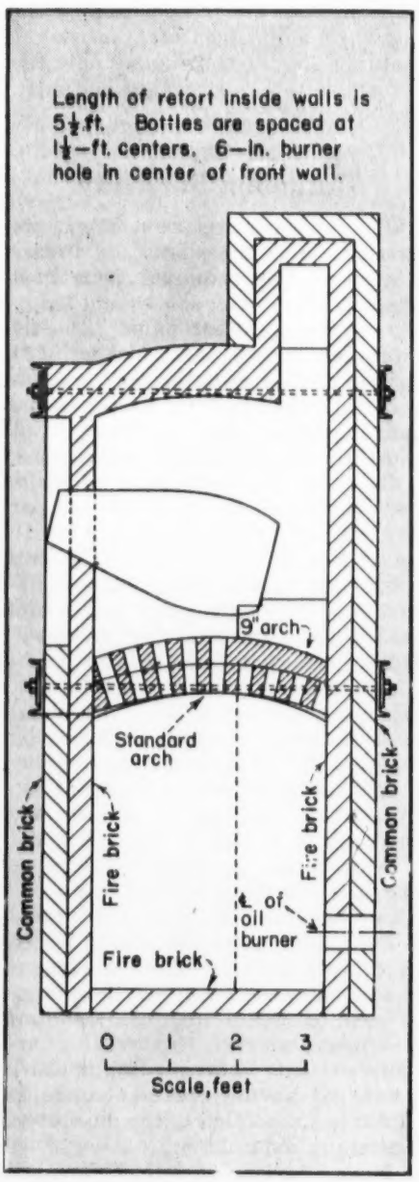
After the press has been filled with sponge and washing operations have been completed, the sponge is blown until the outlet ports of the press are warm. When this point is reached, the air is shut off and the press broken, the sponge being discharged into a bin on the retort floor below. From here the sponge is passed to a Stokes granulator, wherein it is disintegrated and forced through an 8-mesh screen discharging into the feed hopper serving a Stokes Model R tableting machine. The sponge, under 17-ton pressure, is densified and discharged as briquettes measuring 2 in. in diameter and ¼ in. thick.

The briquettes are treated in the two retorts, each containing two bottles. As originally built, trouble was experienced with the brick piers breaking away from the firebrick wall, with consequent severing of the bottle resting thereon. The difficulty was overcome by removing the upright columns and installing a steeper arch of 9-in. firebrick below each bottle as shown in the accompanying drawing. The retorts are oil-fired by No. 210-4 low-pressure North American oil burners. These units receive fuel oil at 180 deg. F., and air from two No. 324-B3-2 North American turbo blowers driven by 2-hp., 3,600-r.p.m. electric motors and capable of delivering 150 cu. ft. of air per min. at 24-oz. pressure. One burner heats both bottles in each retort. Each of the No. 11 graphite bottles is charged with 600 lb. of cadmium briquettes together with 5 lb. coke, of which one-half is placed at the bottom of the bottle and the other half on top of the charge.

About 900 lb. of metal is produced by the two-bottle retorts in 18 hr., which includes charging and removal



CADMIUM BARS are treated with ammonium chloride in this electrically heated holding pot to remove thallium before metal is finally cast for market.


Length of retort inside walls is 5½ ft. Bottles are spaced at 1½-ft. centers. 6-in. burner hole in center of front wall.
9" arch
Standard arch
Common brick
Fire brick
Fire brick
Common brick
℄ of oil burner
Fire brick
0 1 2 3
Scale, feet

GRAPHITE BOTTLE in retort holds a 600-lb. charge of cadmium briquettes. Dotted line shows old column which was replaced by 9-in. arch to support bottle.

of retort residue. The latter is returned to the leach. From the condensers the molten metal is tapped into 7x19x2¼-in. molds, a small amount of candle wax being used in this operation to prevent excessive oxidation. The bars are next charged into electrically heated holding pots. When one unit is full, the caustic cover is removed and the molten metal treated with minus-8-mesh ammonium chloride to remove thallium. After the removal of thallium has been completed, the caustic cover is again placed on the metal. Finally the metal is poured into molds measuring 4x16x¾ in., and in this operation, too, candle wax is used to prevent oxidation and discoloration of the metal. The final bars are boxed, seven to a box and weighing about 100 lb., for shipment to markets.

Plant operations are on a three-shift basis, and each shift completes a leach cycle, seven successive leach cycles being required to fill the two 5,000-gal. pregnant solution storage tanks. The foreman and two helpers carrying out this work then advance to the precipitation operation wherein all pregnant solution in storage is treated. Briquetting starts immediately with the production of sponge and continues until the supply has been exhausted. Retorting is continuous, one man operating the retorts and drossing the holding pots. One extra man, the fifth, is employed on the day shift to cast and box the final metal.

Safety Installations

Auxiliary installations make plant operations efficient and safe. For instance, effective ventilation systems are installed on both the precipitation and retorting floors. These consist of suction pipe-line systems with hooded intakes above each retort, melting pot, and tank unit leading to fans exhausting into the blast-furnace flue. The ventilation installation serving the precipitation tank is so arranged as to include the leaching tank. The fan is an American Blower Co. Sirocco No. 3 unit of acid-resisting construction, and capable of handling 6,400 c.f.m. at 879 r.p.m. and 1½ in. R.P. Gas discharge velocity is 3,600 ft. per min. In the event of a fan failure, an automatically controlled horn warns the men to leave the building. Before the men are allowed to re-enter, the building is checked for arsine gas, and Bullard gas masks are worn by those doing the work. No fan failure has occurred so far, and no free arsine gas has been detected. As the arsenic content in the solutions is very low, there is little danger from arsine gas even if the fan fails.

Solution and water levels in tanks are indicated and controlled by electronic level indicators. These units are on the central sump and the zinc sulphate and wash-water storage tanks. Installations on the central sump and zinc sulphate storage tank indicate the level of the contents and stop the pumps when the tanks are empty. Retort temperature is automatically indicated and recorded and a Bailey Meter Co. semi-automatic temperature control system in conjunction with a fuel-air ratio controller is installed. Monthly plant production has increased from 28,000 lb. in June to more than 50,000 lb. in September. All metal produced is of 99.95 plus percent grade, and is marketed to the plating and bearing industries.

In conclusion I wish to thank J. B. Haffner, general manager, Bunker Hill & Sullivan Mining & Concentrating Co., for permission to publish this article, and gratefully acknowledge the help of Harold E. Lee, research engineer, and F. L. Alsop, of the research department.

Rigid Control of Atomic Raw Materials Urged

A committee of mining and mineral specialists, working under the auspices of the Carnegie Endowment for International Peace, has recommended that the production and sale of all fissible raw materials for atomic explosives should be subject to the inspection and control of an international commission responsible to the United Nations Organization.

The committee, chairmanned by Prof. Paul F. Kerr, of Columbia University, urged that all sources of uranium and thorium capable of producing one pound of uranium per day or more (or the thorium equivalent in terms of the relative power of thorium to provide fissible material) should be placed under control of the international organization. To do this effectively will include studies of the reserves at each property, and constant surveillance by a resident engineer and staff. The committee contemplates that the inspection agency must have the right to enter and move freely through all countries and the privilege of reconnaissance by airplane. It must inspect all properties likely to produce fissible materials as byproducts and license all users under rigid controls.

The committee report states that "The amount of uranium required for prewar commercial purposes is negligible in contrast to uranium consumption for the atomic bomb."*

In regard to the principal sources of uranium and thorium, the report states:

"In addition to the southwestern Colorado region in the United States, the world-wide regions from which major uranium production has come include: Port Radium, at the east end of Great Bear Lake, within 20 miles of the Arctic Circle in Canada; Shinkolobwe, some 70 miles northwest of Elisabethville, in the Belgian Congo; Jachimov (Joachimsthal), about 70 miles northwest of Prague, in Czechoslovakia, an historic locality where metal mining began as early as 1517; Urgeiriea, near Nellas, and Barracao, near Guarda, in Portugal; Cornwall, in England; Mount Painter, in southern Australia; Kvarantorn, Province of Narke, Sweden; Fergana, in Russian Turkestan; Kirovsk, in the Murmansk district, Russia; and possibly deposits in the Caucasus of Russia.

"The commercial source of thorium is monazite sand. The mineral monazite is a complex phosphate of the rare earths containing 2 to 10 percent of thoria. The principal deposits are located in Travancore, India, which has been reported to yield three-quarters of the world's supply. Monazite sand is also found in Brazil, Australia, the Malay Archipelago, North and South Carolina, and Idaho. Before the war the world's annual consumption of monazite was reported to be about 3,000 tons."

The committee report will be published as a joint publication of the Geological Society of America, Carnegie Endowment, and A.I.M.E.

*Considering that only a few pounds of fissible material is needed for a bomb, that the prewar consumption of uranium was of the order of 1,000 tons per year, and that plutonium is synthesized from ordinary uranium, this seems to be an ultra-conservative conclusion.—Ed.

Limestone Replacements Refute Theories of Origin

BASIL PRESCOTT, Mining Geologist, Los Angeles, Calif.

Are the generally accepted ideas of ore deposition and their corollary, the zonal theory, breaking down under the weight of evidence? Here is the viewpoint of a mining geologist of extensive field experience, whose observations fail to confirm the conventional hypothesis.

THAT PHASE OF ECONOMIC GEOLOGY which deals with primary ore deposition has done little to warrant a place among the sciences in the last forty years. The now accepted concepts, when reviewed in the light of field observations, so often fail to satisfy the conditions met, that it becomes increasingly apparent that there is something very wrong with our basic hypothesis of primary ore genesis.

In the following discussion no attempt is made to present a new theory. I am convinced that my field experience or that of any other single observer has been too limited to justify any such an attempt. The viewpoint taken is that of the Cordilleran field geologist. When instances are cited, they are from personal experience, and only a small part of the entire field is touched. The attempt is to point out first why there is reason to doubt our present hypothesis, and, second, to call attention to certain facts and conditions that must be met and satisfied by any theory of ore genesis worthy of support.

Accepted Theory Reviewed

The generally accepted theory of ore deposition as now taught and practiced may be summarized as follows: During the differentiation of a magma which freezes to a normal intermediate or basaltic type of igneous rock, a differentiate essentially high in silica and volatiles is given off over an extended period of time, and rises as a mineralizing solution along such channels as exist. Upon reaching a higher zone of the earth's crust, where temperature and pressure are lower, the contents of the solution are deposited, each mineral in turn crystallizing out when its point of critical temperature and pressure for the solution has been reached.

This process continues until an ore deposit is formed. The chief volatile called for in the differentiate is almost invariably considered to be water, and, as the solubility of many of the common ions in dilute solutions is extremely slight, the volume of the water involved is consequently enormous. The increase of temperature and pressure with increasing depth as the predominant control in ore deposition has been for years the basis of our most commonly used classifications of ore deposits. There are dissenters from the views expressed in the foregoing but too often they have allowed themselves to be silenced by the majority or to become discouraged by the apparent futility of making a protest.

A Corollary

The most obvious corollary of the accepted hypothesis is that the metals or minerals in an ore deposit should be arranged in a regular sequence according to their critical points, which sequence, unless diastrophically interrupted, should be constant, progressive, and practically universal. We are assured that such is indeed the fact, but through a long field experience I have failed to be impressed with the evidence. Conceivably this could happen to any single investigator, and still not disprove the hypothesis, but upon inquiry it becomes evident that my own experience is by no means unique.

My field has been limited chiefly to that type of ore deposit commonly called "replacement deposits," and, again, further limited in the main to those in limestone or dolomite. The field covers workable deposits embracing a fairly wide range of metals, chiefly gold, iron, copper, zinc, lead, silver, tin, antimony, arsenic, and mercury, with gangues varying from essentially pure silica, through gangues composed of many different silicates, or the various carbonates, to deposits in which the gangue minerals are practically absent.

These deposits, because of their simplicity, offer an exceptional opportunity for study of the genesis of ore deposits. The wall rock of the limestone "replacement deposit" is composed of a single formation; that of a vein, for example, may be composed of many different rocks. The composition of the wall rock, essentially calcium carbonate or calcium magnesium carbonate, is simple compared to that of the average vein, as for example a schist or an igneous rock.

However, there is one far more important difference between vein deposits and limestone replacements; in the former, successive time stages are likely to follow the same channel, and the fissure is usually the locus of many mineralizations; in the latter they almost never do so, and successive time stages are represented by individual orebodies. Hence, though the stages may be found close together, and often side by side, the actual superimposition of one stage over an earlier, as appears to have happened with such frequency in veins, is practically unknown in limestone.

Zoning Not Apparent

After many years of specialization in limestone "replacement deposits," I cannot recall from my own observations one conclusive example of progressive change in the mineral content of a single definite primary orebody in limestone, as that orebody was followed downward towards its source.

One engineer's experience in one lifetime is far too limited to enable him to establish many principles based on inductive reasoning. My own experience certainly checks that of the superintendent of a Colorado camp, who, when reminded that his deposit had been classed among those that illustrate the zonal ar-

rangement with depth, admitted that it might be true but that the mile on the dip explored to that date gave no corroborative evidence. The records were exceptionally complete at this property, and even a minor variation in zinc or lead would certainly have been detected, at least when the extremes were compared. Several distinct inclined chimneys or plunging mantos were involved and each seemed to have and to hold its own strict individuality. The orebodies which showed near the surface a few percent more zinc than lead, remained so as far as followed; also, those that were marked by the presence of a few percent more than the average lead, remained so to the bottom of the mine workings as then determined, and both were remarkably uniform in grade from near the outcrops (below the limits of oxidation) to the breast.

Mistaken Interpretation

Some years ago an example of apparent zoning was investigated. A large stoped area in limestone, apparently a single great chimney standing in nearly vertical limestone beds, was presented as a complete stope projection, with accompanying assays, each representing several thousand tons, arranged alongside of the point from which they were taken. The evidence seemed to show a chimney extending over a vertical range of about 1,400 ft., assaying 23 percent lead at the top, 15 percent lead a little lower down, 7 percent at a still lower horizon, and 2 percent lead at the bottom. Apparently the lead was falling off with increasing depth. When the occurrence was subjected to careful study, made possible by the extraordinarily well-kept maps, and a smelter analysis for each 100 tons produced, new projections were built up from stope sheets, showing the floors on each square-set level, together with the shipments taken therefrom. The composite chimney was thus found to consist of a number of individual chimneys, each constant in grade and analysis as well as in area of cross-section, and each clearly separated from the others by nearly unaltered limestone. At only one point did two bodies practically touch; at this point there was at least 3½ ft. of limestone between the two pipes. There were represented in the group: one siliceous gold ore and one dry silver ore, as well as distinct combinations of silver-lead-zinc including minor percentages of copper. Each orebody, for as far as it was followed, remained constant and showed no tendency to grade off to the analysis of a neighboring pipe, nor to vary progressively in the metallic content which distinguished it from its nearby associates. In this operation and in others that could be mentioned, mineralizations ordinarily given positions far above one another were occurring together at the same horizon. In fact, the range from gold-bearing quartz through to dry silver probably covers a considerable part of the entire range of deposition. It could be advanced quite reasonably in refutation that each represented a distinct time stage, separate from each of the others by a greater or lesser period. Nevertheless, if all came from the same magmatic source, which, judging from our literature, would be normally assumed, it must be admitted that it would be difficult to build up a sufficiently complex history to account for the great variation in temperature and pressure for all these stages occurring so closely spaced, so distinctly separated, and yet so completely overlapping.

Some of the confusion and much of the discrepancy between the observations of such occurrences arise from the failure to distinguish individual orebodies. What marks the individuality of the orebody? Evidently the same things we are discussing and using as criteria: grade, metallic ratio, primary minerals, continuity, and size but not shape. For example, a primary orebody assaying 25 percent lead and 25 oz. of silver is followed downward on its plunge, in a limestone bed dipping say 30 deg. from the horizontal, for 1,000 ft. or so, with its metallic ratios, grade, and size fairly constant and the orebody continuous except where faulted. It then runs into trouble for say 40 ft., and apparently emerges from the trouble with an entirely different grade, about half the size previously shown and a new plunge in a new limestone bed. It is fairly obvious that the new strike is not the same orebody, no matter how apparent it may seem that it is. The point of trouble should be investigated with particular emphasis on post-mineral faulting, and the continuation of each of the two orebodies should be sought, on the opposite sides of the trouble spot.

If there is no progressive variation with increasing depth in a single limestone orebody, as my experience seems to indicate, either our premise is wrong or we are dealing with ranges for the separate stages far greater than we have been accustomed to consider and far greater than the limited depth of our mines serves to illustrate. L. C. Graton, in his excellent and timely paper, "Depth Zones in Ore Deposition,"[1] takes the latter position, certainly worthy of the most serious consideration. However, if to account for our failure to find progressive changes in even our deepest workings and exposures we increase the ranges of the zones until we call for as many miles of depth as formerly were covered by the same number of thousands of feet, we certainly must face the fact that supporting evidence of our hypothesis is becoming increasingly scarce. Furthermore, we are reducing to an absurdity the never very plausible concept of a complex history to account for the occurrence of so many zonal types in juxtaposition. Also, we extend the zone of deposition to such a point that a source far below that usually considered would be forced upon us.[2]

A Conclusive Example

Occasionally an ore deposit in limestone yields relatively accurate data as to the actual depth, below the surface, at which deposition took place. Sierra Mojada, in the central Mexican plateau, is an example. A pre-mineral volcanic agglomerate partly filled the valley along one edge of which the town and mines lie, at the base of a towering limestone cliff several thousand feet high. The upper limits of the volcanic agglomerate can be established against the cliff; in fact, little erosion has taken place since it was laid down. Several recemented masses of crushed limestone, of perhaps an acre in extent and a thickness measurable in tens of feet, lie on and protect the upper surface of the agglomerate and are made up of rock apparently fallen from the limestone cliff. The upper surface of the agglomerate now slopes gently toward the bottom of the valley. The under side lies on an erosion surface that similarly slopes from the cliff at a slightly steeper angle.

The major production has come from orebodies found in the gently dipping limestone beds below the agglomerate. Considerable production has been taken from the contact between the limestone and the under surface of the agglomerate, and I personally directed work which followed mineralization of the "replacement deposits" up into the agglomerate for about 75 ft.

The mines of Sierra Mojada are famous for their high-grade silver-

[1] *Econ. Geology*, Vol. XXVIII, No. 6.
[2] C. H. White, *Econ. Geology*, Vol. XL, No. 5.

lead and zinc carbonate ores, and the orebodies are strong and continuous for great distances. Even a body with a very small cross-section was followed for a mile. Other ores occur, such as dry silver with accessory barite, and a sphalerite-chalcopyrite mixture that is largely primary and unaltered. The trend of the known ore zone is roughly parallel to the base of the cliff, and the vertical range exposed by mine workings is of the order of 1,500 ft. This is the result of a slight plunge of the bodies throughout their great length, for the vertical range in any given cross-section is slight indeed.

The depth at which the deposition took place below the surface is not appreciably greater than the depth of the stopes below the present surface; certainly not more than two hundred feet, over a considerable area. The crushed and recemented limestone lying on the surface of the agglomerate was mined in a small way for silver-lead-zinc carbonates, introduced after the recementing had taken place, with a resulting depth, at time of deposition, of tens of feet. The sphalerite-chalcopyrite orebody was deposited at a depth of the order of 300 ft. below the upper surface of the agglomerate, in the same area that contained the recemented limestone orebodies. This not only seems to put all these mineralizations in the shallow zone, but there does not seem to be much that can be done about the geologic history to give an adequate explanation for their occurring together in harmony with accepted theory.

Unlike Associates

The contents of individual orebodies themselves often give combinations of minerals that are difficult to account for under the hypothesis of temperature and pressure control and difficult to place in the classification commonly in use. For example: A series of rather closely spaced gold ore pipes in steep limestone beds shows such a wide variation in mineral content of each, as compared to the others, that they can be distinguished one from another with the greatest ease and assurance. One of these pipes carried a few pounds of cinnabar per ton as an accessory mineral. Tests on composite pulps from the shipments of the gold ore showed no variation in the number of pounds per ton of the cinnabar, from the 1,200-ft. level to the surface. True, the range involved is small, but, as the conditions are constant, some allowance should be made for additional footage above the outcrop and below the present bottom, still strong and encouraging. A relatively dry silver ore in unmetamorphosed limestone, and not associated at known horizons with igneous rock, is followed through a thousand feet or so of vertical range. It tops under shallow Tertiary deposits as a sulphide. Among the silver minerals is ruby silver, and among the gangue minerals is olivine in quantities measurable in thousands of tons. A series of gold-quartz orebodies, long considered of deep-seated origin, has one that carries almost commercial quantities of stibnite.

Terminations Are Abrupt

It may appropriately be asked how far conditions, such as constant grade, metal ratio and mineral content, continuity and size, which we say mark the individuality of the orebody, may be expected to continue with depth. The answer can only be that we do not know; that in general they certainly should continue downward for some distance, as no evidence of any tendency to the contrary has as yet appeared. But although our knowledge of the downward limits of individual orebodies is now indefinite, fortunately the upward limits of orebodies are more satisfactory. Some do not outcrop, but have their upward terminations below the present surface.

In general, if a limestone replacement orebody is followed upward from the lowest point available it will be found to rise continuously. For considerable distances, of the order of one to two thousand feet, it may lie nearly horizontal, or it may stand nearly vertical, have sudden and unexpected changes between the two, or it may lie at any angle between the extremes. An orebody may cut the beds at nearly right angles, or it may follow the beds with remarkable persistence. More frequently than not, still judging by the few examples sufficiently developed to give evidence, orebodies have a tendency to split and ramify, particularly as the upper reaches are approached. There is also found to be a somewhat gradual though slight diminution in the cross-section area of orebodies as they are followed upward, which diminution continues until finally they terminate completely. The rate of decrease varies considerably, as would be expected, but a normal rate, in the middle reaches of an exposed orebody, would require at least a thousand feet of length to establish convincingly that a decrease is taking place. Other rates far more abrupt have been noted, chiefly as the upward terminations are approached, and, finally, the end itself is far from the simple converging of two almost parallel lines, but is dubbed off while the orebody still has appreciable breadth. Too little is known regarding the rates at which these orebodies may increase in cross-section with depth to attempt generalities, but it may be that only the upper courses diminish so rapidly, the orebody below settling down to a bore that is maintained with some constancy.

The point pertinent to our discussion is that in no instance recorded in my experience does the upward termination fail to produce ore of the grade and characteristics that marked the orebody throughout its course, and up to its very end. This is true of all branches of the orebody, even though their extremities may be separated thousands of feet horizontally and a thousand or more feet vertically from one another. Moreover, one part of such a system may be a mile or so nearer some associated igneous mass, such as is so often pointed out as a probable source. Above all, we fail to find any tendency for the mineralization to pass over into that succeeding stage expectable under the premise of progressive sequence. These terminations take place at variable depths from the surface that we believe to have existed at the time of ore deposition, as well as at variable depths below the present surface.

Where Do Solutions Go?

There remains to be investigated the solution which, after depositing a given stage, presumably continues upward with its load of minerals to be deposited in a higher zone. For the sake of an example we will take a silver-lead-zinc orebody with the usual pyrite and silica, a common type in the limestone replacement deposits, and one that would not be considered an end type for this kind of mineralization. We follow the orebody upward without change in grade or metal ratio, until we reach one of its ends. At this point the residual solution should still contain some lead and less zinc; most of its silver, the minerals of the shallower zones, and enormous quantities of the volatiles, chiefly water. As the ore has played out, we will assume that we are dealing with the "extended" type of deposition, calling for stages separated from one another by gaps in the deposition. Let us examine the ground and see what sort of deposition we really have up-

ward and beyond the termination of the orebody. The answer is "None." The orebody plays out in the face in the same manner that it terminated along the side walls for the miles that these have been exposed to view and study by mine operations.

If there is no continuous deposition, we still must remember that the solution which is presumed to deposit all the relatively higher zones still has to pass along and deposit its load somewhere. However, we find no evidence of such passage or such deposition. Moreover, regardless of subsequent deposition, the enormous amount of solution presumably involved in the formation of the known ore deposit must have continued upward whether it contained any undeposited metals or not. No host rock can be imagined more suitable to catch and record the nuances of the process than the limestone which surrounds the orebody. Certainly the volume of the solution presumed to be involved connotes that the evidence of its passage should not be obscure. However, we find no signs of any deposition beyond our terminations, no silification or intense alteration, often no channels along which the solution might have passed in fact, no evidence that anything has passed—gaseous, liquid, or solid. Beyond the ore limits there is simply unaltered solid limestone. Apparently there were no volatiles, with or without a metal load, left over when deposition was completed and consolidation took place. Once again these so-called limestone replacement deposits fail to support the most essential requirements of accepted theory.

Are Solutions Dilute?

It would seem, then, that the theory of progressive deposition from hot ascending aqueous solutions with decreasing temperature and pressure is a very unsatisfactory one when applied to limestone ore deposits. The hypothesis certainly was not developed by any reasoning based on the occurrence and habits of such orebodies as these, and it certainly does not cover and satisfy the conditions found therein. We are told that the physical chemists stand ready to help us, but they need a restatement of our problem before they undertake to give a satisfactory explanation of the processes involved. It is one thing to be called upon to consider the precipitation of ore from a dilute solution; it is another problem to consider a process that continues until the material is used up.

Silver Peak Intrusive Ore

The most common of the so-called deeper-seated types of ore deposits is the gold-quartz orebody with or without minor amounts of other metals. This is an exceedingly common type among the so-called replacement deposits throughout the Cordilleras; so much so, that in some regions it is harder to find a desert range that does not contain such a deposit than it is to locate one which does. Many "desert blowouts" are the surface expression of this type of mineralization, little understood and less appreciated.

Thirty-nine years ago J. E. Spurr examined such an occurrence at Silver Peak, Nev., and his findings were published by the U. S. G. S. as Professional Paper No. 55. In the middle thirties I spent several years studying these deposits and directing their development.

We are interested here only in certain aspects of these occurrences, pertaining to some of the main deposits lying along Mineral Ridge and its flanks. The orebodies are essentially pipes or mantos lying at flat angles, seldom exceeding 20 deg. There are no continuous veins, although the abundance of mineralization in the heart of the district gives that impression. The ore occurs chiefly in the limy members of a sedimentary series, as a number of pipe-like runs, flattened in cross-section to conform with the strata. Individual orebodies vary in size, but the larger ones are of the order of 25 ft. in thickness and 150 ft. in width, with a length along their plunge still undetermined. These orebodies "shouldered their way"[3] through the sediments, thrusting them aside and causing minor flexures of the beds. Not everywhere is there unmistakable evidence of the process implied, but it is observable particularly in the outlying areas, where the lesser mineralization permits better appreciation of the conditions. Occasionally side walls have been exposed which for 100 ft. or more in length show that the ore shoved the country rock aside and did not replace it. The quartz at such a place terminates along the side wall in a rounded curve and shows delicate but distinctly discernible banding parallel to the curved outer wall and extending into the quartz for several inches. The limestone beds split at the extreme point of the curved quartz sidewall and divide to pass over the top and under the bottom of the quartz orebody. The curve of the beds upward over the quartz is quite sharp and is more marked than in those which pass under the orebody, showing that the dislocation of the beds by the ore consisted of lifting the overlying beds rather than depressing the underlying ones. This banded, intrusive, curved side wall is by no means the usual or generally prevalent side wall condition at Silver Peak. Most of the orebodies present no such simple forms, with their startling implications, but, like most orebodies the world over, yield very little positive evidence as to their origin.

At Silver Peak the clearest examples are usually encountered in stoping operations, but can be found in abandoned stopes and mine workings, on the surface outcrops, and, as might be expected, in unminable miniature expressions. Also, throughout the desert ranges they are occasionally encountered at some points.

It is felt that any acceptable hypothesis of ore genesis must cover such occurrences as these. It is not contended that all limestone ore deposits were formed by forcing the sediments aside, as the evidence is overwhelmingly against this in the majority of cases. But if plans, projections, and cross-sections of individual orebodies in limestone, without identifying data, were presented, it would be impossible to classify them from such maps as to their depth zones, age, location, mineral or metallic content, wall rock, or gangue. All follow the same controls, obey the same laws, and have the same habits. All are extremely individual, and differences between two examples of the same group are usually far more striking than those between groups, no matter on which of the criteria classification is attempted.

New Theory Needed

If the seat of magmatic differentiation is held to be the ultimate course of the ores and metals, limestone replacement deposits call for a far more intricate and extended differentiation than has usually been contemplated. If differentiation is to be held the controlling process of ore deposition throughout, we cannot stop with the heterogeneous mixture of volatiles, metals, and silica, now considered to be the end product of magmatic differentiation, but must continue the process, either at the "seat," where the mixture is thought to have accumulated as a residual mother liquor, or in the channels leading from that seat toward the final resting place, carrying on the

(*Continued on page* 153)

[3]Spurr, *op. cit.*

Sunshine's Modernized Hoist Uses Rotating Control

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H. B. HODGINS, Manager, Westinghouse Electric Corporation, Spokane, Wash.

CURRENT AND TORQUE LIMITS determined by a Rototrol control system to protect the electrical and mechanical equipment are but two of the benefits resulting from modernizing the Jewell hoist of the Sunshine Mining Co., Kellogg, Idaho. Other improvements are: speed-control matching cable stretch at lower levels; speed change of only about 3 percent plus or minus from zero to 140 percent of full torque loading; a definite maximum speed, but one that is adjustable; maximum hoist cycles with less heating of electrical equipment; added safety features; and the simplest possible control system.

This double-drum Nordberg hoist, originally installed in 1918 by the Butte & Superior Mining Co., in Butte, Mont., was designed for handling men and supplies on double-deck cages. However, service from the start was heavy in that three-decked cages were used instead.

The original equipment included a flywheel-type motor-generator set with liquid slip regulator and direct-connected exciter with voltage regulator. The generator was rated 500 kw. and 500 v. The 600-hp., 450-rpm. hoist motor was connected to the main shaft through a single reduction gear. Adjustable voltage control was provided by a large faceplate rheostat in the generator field, operated by a linkage from the control lever on the hoistman's platform.

The hoist was taken out of service in 1930 and installed by the Sunshine Mining Co. for operation at the Jewell shaft in 1935, where it has been in continuous operation as the main ore hoist.

At that time the slipring motor and the flywheel were removed from the motor-generator set and a synchronous motor was installed. This change eliminated the flywheel losses, obtained a better motor efficiency, improved power factor, and simplified the control. The liquid slip-regulator and the exciter voltage-regulator were eliminated and a simple starter was installed for the synchronous motor.

From that time on, the duty on the old hoist increased steadily as the mine depth increased. Records of the mine's output give this picture of the increase in the duty:

In 1938, 33.6 percent of the output was from the 2,300-ft. level and 47.1 percent from the 2,500-ft. By 1940 approximately 31 percent was coming from each of the 2,700-ft. and the 3,100-ft. levels. In 1942, 66 percent was coming from the 3,100-ft. level and 12.6 percent from the 3,700-ft. level, with all appearances indicating that the 3,700-ft. level would develop into the big production area. Since 1942 the percentage output from the various levels has remained about the same, principally because of a shortage of manpower; also the discovery of new orebodies at the lesser depths.

Increase in duty brought expected difficulties with operation and with equipment. The overloaded hoist motor gave occasional troubles. The exciter, which has been designed for operation from a speed of approximately 700 down to 595 rpm. with the flywheel set under control of the voltage regulator, was worked so low on the saturation curve that regula-

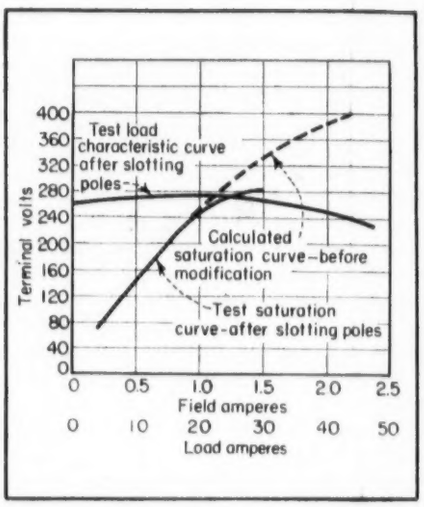
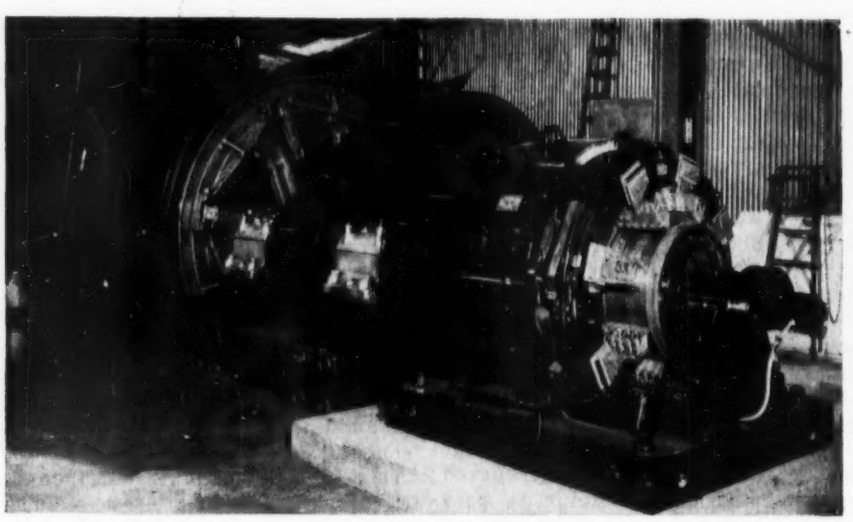


FIG. 1. Characteristics of the exciter were changed by slotting field poles to adapt old equipment to new conditions. Note nearly constant voltage of load curve.



NEW 700-HP. MOTOR coupled to old Nordberg hoist and gearing was originally installed in Butte district in 1918 and moved to the Sunshine mine in 1935. The new motor and control have converted this old unit into one of the most modern installations in the Coeur d'Alene district. Power is supplied to this motor by a synchronous motor and generator.

tion was very poor. Maintenance was climbing undesirably and the reliability of control under the heavy overloads was becoming questionable. With purely manual control, motor over-currents, and, therefore, also excessive torques on the mechanical equipment, were entirely in the hands of the operator.

Results Desired

The principal aims in modernizing the drive, therefore, were:

1. To obtain increased mine output from the lowest levels with safe equipment temperatures.
2. To provide more accurate speed control.
3. To obtain the same speed on any control point, regardless of the load that might be in the skip.
4. To have a definite but adjustable maximum speed.
5. To have a definite but adjustable maximum current to protect the electrical equipment, and a limited maximum torque to protect the mechanical equipment.
6. To reduce the danger from possible mis-operation or abuse on the part of the hoistman and to include added safety features.
7. To maintain as nearly as possible the simplicity of the old control system with directly operated face plate rheostat.

A study of the design characteristics of the original equipment, and of the synchronous motor which has been added, showed that under the operating cycle as it then existed, the hoist motor was the weakest link in the chain. A new 700-hp. hoist motor was designed with thermal characteristics to match the generator and the synchronous motor of the motor-generator set. Mechanically it was made fully interchangeable with the original 600-hp. hoist motor, which is being kept as a spare.

A check of the design of the old exciter disclosed that by slotting the field poles its characteristics could be stabilized and its regulation considerably improved. In the machine shop at the mine a slot ½ in. wide and ⅞ in. deep was cut in each side of each field pole. The curves in Fig. 1 show the regulation and saturation curves after this modification. The calculated saturation curve of the original design has been added for comparison.

The replacement of the old control system with a Westinghouse Rototrol rotating control system was the main factor in accomplishing the aims desired. The rotating unit of this control system is a simple, three-unit motor-generator set, mounted behind the control panel.

Results Achieved

Results obtained by the foregoing changes and installation are:

1. There has been no fair opportunity to test for increased output over a long period of time, because

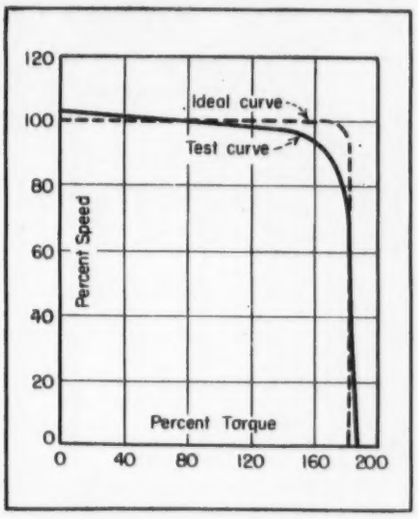


FIG. 3. Speed-torque characteristic obtained with Rototrol. An actual test curve is compared with a theoretical ideal curve.

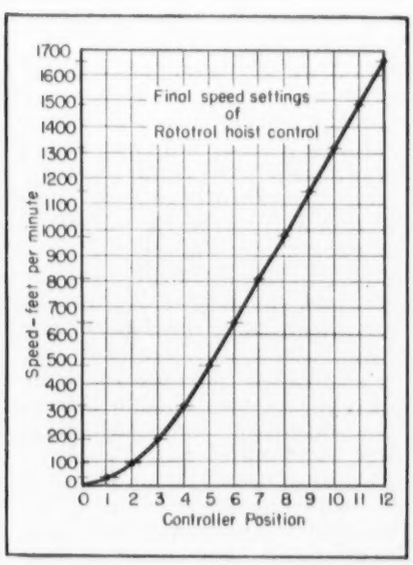


FIG. 2. The hoistman relies on the Rototrol to produce definite skip speeds for each setting of his controller regardless of load in skip. This curve was made from actual test. Speeds on first points were set to compensate for stretch in cable while skip is being loaded at 3,700-ft. level loading pocket in shaft.

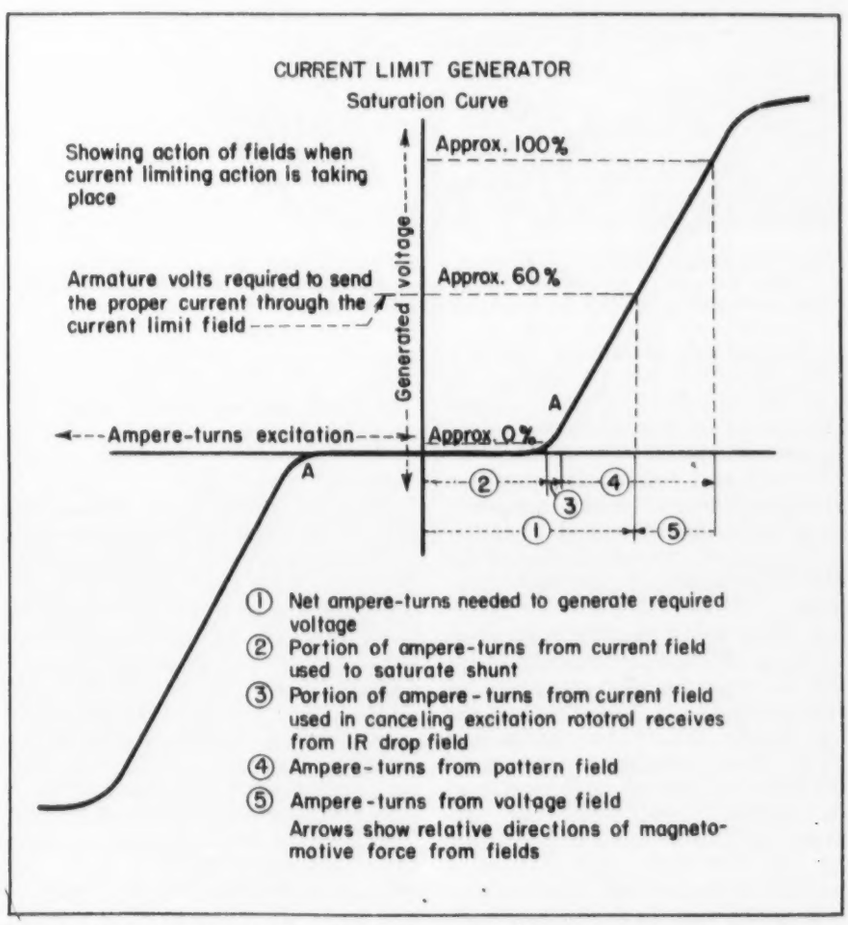
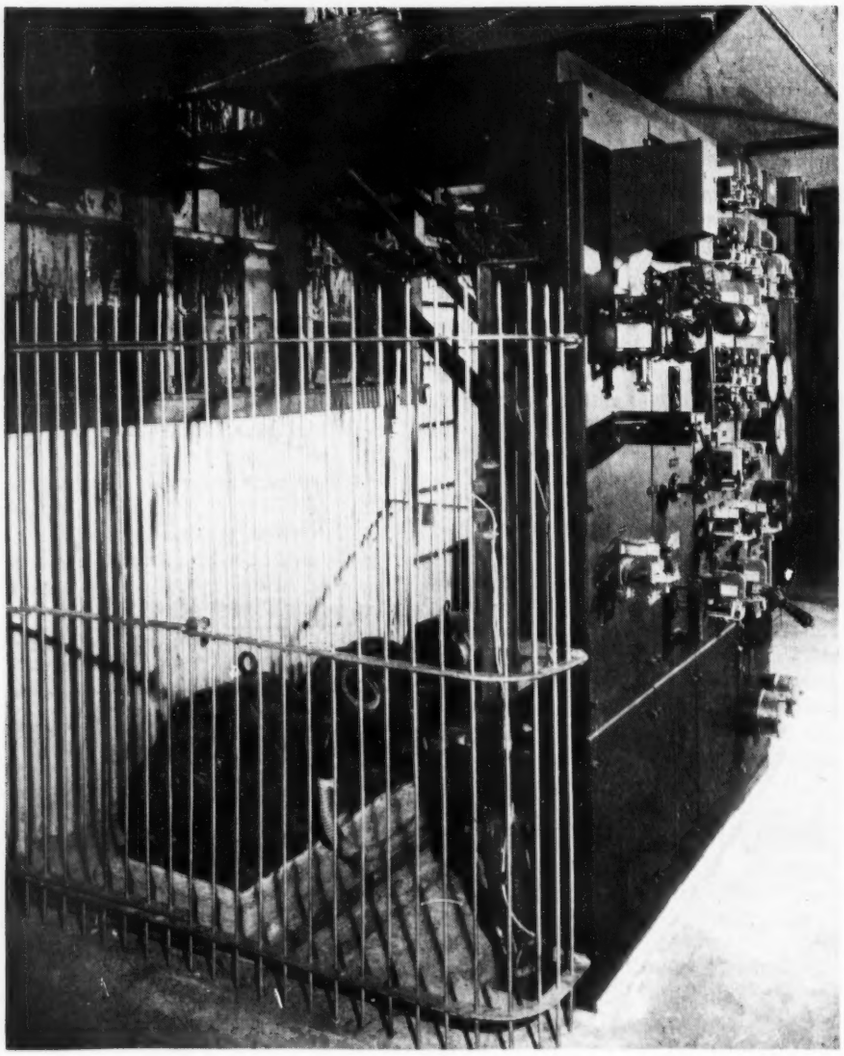

CURRENT LIMIT GENERATOR
Saturation Curve
Showing action of fields when current limiting action is taking place
Armature volts required to send the proper current through the current limit field
Generated voltage
Approx. 100%
Approx. 60%
Approx. 0%
Ampere-turns excitation
A
A
1 Net ampere-turns needed to generate required voltage
2 Portion of ampere-turns from current field used to saturate shunt
3 Portion of ampere-turns from current field used in canceling excitation rototrol receives from IR drop field
4 Ampere-turns from pattern field
5 Ampere-turns from voltage field
Arrows show relative directions of magneto-motive force from fields

FIG. 4. With the old installation the hoistman had to keep his eye on the ammeter to avoid sustained current overloads which might have damaged the hoist motor. Now the hoistman relies on the Rototrol to keep the current within safe limits automatically as shown more technically in the diagram shown above.



ACCURATE SPEED CONTROL, regardless of load on the hoist, and current limit protection to prevent damage to the electrical equipment, are provided by the Rototrol, or rotating control, unit mounted behind the control panel of the Sunshine hoist.

of the shortage of miners. There is little doubt, however, of meeting the requirement of increased output with minimum temperature rise and mechanical strain. The uniform acceleration and deceleration, together with the definite known maximum speed and current and the positive speed control, permit faster cycles with less heating of electrical equipment.

2. That speed control is accurate is shown by Fig. 2, which shows the final set speed for each controller position, actual test. The speeds on the first points are to be particularly noted. These speeds are determined to match the rate of cable stretch at the 3,700-ft. level while the premeasured load is being dumped into the skip. The hoist must take up at the same rate the cable is stretching to keep the skip in the proper loading position.

3. It was impractical to test the Sunshine installation for speed with maximum and minimum loads at each point. However, Fig. 3 shows the speed torque characteristics, actual test, of a similar installation.

4. Maximum speed limitation for any load is also shown by Fig. 3.

5. The current and torque limitations are determined by one of the rotating units, a current-limiting Rototrol. This works through a current-limiting field on the main Rototrol unit. Through a field pole construction that shunts flux up to a certain limit, this current limiting Rototrol is prevented from having any effect up to a predetermined excitation. Beyond this, its characteristics are normal, as shown on Fig. 4. The breaking point, at which the current limiting Rototrol begins to have effect, is determined by a field winding which excites it in proportion to the main d.c. current. The amount of corrective effect it exerts at any instant beyond this point is determined by the relationship between the voltage of the main d.c. circuit and the strength of the main Rototrol pattern field. Thus the corrective effort is proportional to the correction required.

6. Many of the safety provisions now considered standard and necessary for modern hoist operation were not commonly used at the time the original control was built. The complete replacement of that old control made it very practical to add such safety features as brake interlocking switches, brake wear switches, back-out switches, a killer field operation to prevent possibility of circulating currents while hoist is standing, and weakening of motor field during standstill to reduce field heating. In addition, the current-limiting feature prevents abuse of the mechanical as well as the electrical equipment if the operator attempts too rapid acceleration, deceleration, or reversal. Mechanical operation is made much safer when skips enter the automatic dump position because the hoistman realizes that his hoist speed is definite, depending upon the position of his controller. This is regardless of the load that may be in the skip or varying unbalance due to different lengths of cable to the lowered skip.

7. Use of the Rototrol system maintained simplicity for the new control. The face plate rheostat under the hoist platform was replaced with the master controller for the Rototrol pattern field. The rotating units are all essentially standard machines of simple construction with which mine electricians are inherently familiar. No voltage regulators, potentiometers, capacitors, stabilizing transformers, or delicately balanced rheostats are necessary. A minimum number of contactors are used. The rotating unit was mounted directly behind the control board.

As is usual with mining operations, it was necessary to make the change over to the new motor and the new control speedily. Adjustments and minor replacements were to be made on the mechanical parts of the hoist at the same time. Before shutdown, therefore, the work was carefully laid out, and all details were scheduled. Color-coded control wires were run in and identified by tags. Everything was placed in readiness, and the crews and foreman were so scheduled that immediately after the shutdown, one group of mechanics started to work on the hoist; another group of mechanics, the motor changing and aligning; and the electricians, the removing of the old hoist control and installation of the new control.

New Methods Cut Costs for Chamberlain Manganese

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Only in the field of placer mining could a simpler method of mining and milling be found than the one described in this article. This latest, and simplest, method advocated for working the Chamberlain, S. D., manganese ores involves mining the ore with scrapers and milling it with conical rolls. Costs are sharply reduced, compared with previous proposals.

THE EXTENSIVE LOW-GRADE manganese deposits of the Missouri River Valley in South Dakota have been studied for many years. The low tenor of the ore has made it difficult to mine and treat the material at a cost within the realm of commercial possibility. Outcropping beds of manganese-bearing material average 40 ft. in thickness are flat-lying, and extend for about 150 miles down the Missouri River from Pierre, S. D., on both sides of the river. The deposits comprise one of the world's largest undeveloped reserves of manganese, in terms of metallic manganese. The Federal Bureau of Mines has spent several years endeavoring to devise a method whereby the ore could be mined and beneficiated cheaply.

At Chamberlain the manganese occurs in concretionary nodules composed of a complex iron and manganese carbonate (manganosiderite and perhaps some manganocalcite; rhodochrosite has not been identified). The color of the nodules varies from black at the surface through dark orange and yellow, and finally, as nodules are found deeper, the color is dirty gray. The matrix in which ore nodules occur is known as Pierre shale and is composed of interbedded layers of bentonite and clay minerals containing disseminated bentonite particles. In this formation the clay minerals have been identified as belonging to the montmorillonite-beidellite series. The shale weathers to the very sticky, slithery, gumbo characteristic of South Dakota and well known to hunters and travelers in the area.

The site selected for experimental mining and pilot-plant work by the Bureau of Mines is in an area about 8 miles west of Chamberlain, S. D., near the village of Oacoma. Here the pilot plant lies a few hundred feet north of U. S. Highway 16. J. P. Gries and E. P. Rothrock, in two publications by the South Dakota Geological Survey, entitled "Manganese Deposits of the Lower Missouri Valley in South Dakota" (R. I. No. 38, 1937), and "Missouri Valley Manganese Deposits Between Lower Brule and DeGrey" (R. I. No. 46, 1943), have described the geology of the area.

General Manganese Corporation has shipped some manganese nodules. It is understood that from 1928 to 1931 approximately 1,000 short tons of nodules was produced and that 1,687 long tons was shipped in 1941 and 1942. Most of this went to the Electro Manganese Corporation at Knoxville, Tenn., which used the nodules in producing electrolytic manganese.

Many methods of treating the manganese-bearing shale have been tried, including: (1) disintegration of ore by trommel breaker; (2) explosive shattering; (3) screening dried material; (4) washing raw ores; (5) attrition grinding; (6) differential grinding; (7) kiln drying followed by slaking and log washing; (8) hand picking; (9) float-sink process; (10) jigging; (11) scrubbing in Tyler-Niagara scrubber; (12) hydraulic mining and sluicing; (13) use of granulator and conical rolls (clay-working machinery) with power-shovel-mined material; and (14) conical rolls alone with ore mined by scraper. Some of the preliminary laboratory work was covered by Bureau of Mines R. I. 3613 in 1942, "Concentration of Manganese Nodules From

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MINING MANGANESE ORE at Chamberlain, S. D., with an Allis-Chalmers tractor and a LeTourneau Carryall. The U.S.B.M. discovered that the strata bearing the manganese nodules alter on exposure to weather to a form most effectively mined by scraper and milled by methods equally simple. Costs are therefore low.

Metallurgical Results, Scraper Mining and Conical Rolls

Roll shells operated at 196 r.p.m.
Moisture content of ore 21.1 percent

Product	Dry Wt. Tons	Percent Wt.	Assay, percent										
			Mn	Fe	TiO_2	P	SiO_2	Al_2O_3	CaO	MgO	S	Ign. Loss	Percent total Mn
Concentrate	7.815	4.6	18.1	6.8	0.36	0.44	15.3	2.7	11.4	2.5	0.14	28.6	36.8
Roll tail	171.317	95.3	1.5	1.6	0.67	0.12	57.7	14.3	2.7	2.2	0.25	10.5	63.1
Minus ⅜-in. screen tail	0.211	0.1	2.5	2.0	0.60	0.10	55.0	13.7	3.1	2.3	0.30	11.1	0.1
Total tail	171.528	95.4	1.5	1.6	0.67	0.12	57.7	14.3	2.7	2.2	0.25	10.5	63.2
Composite	179.343	100.0	2.3	1.8	0.65	0.13	55.7	13.8	3.1	2.2	0.24	11.3	100.0
Roll conc.	8.026	4.7	17.8	6.7	0.35	0.43	16.1	2.9	11.2	2.4	0.13	28.2	36.9

Chamberlain, S. D.," by DeVaney, Shelton, and Lamb.

Laboratory and pilot-plant tests determined that separation and concentration of the manganese nodules could be secured in all but methods 5, 7, and 12. The cost of concentration in most instances was far too high to provide for economic production of manganese except under the direst emergency.

Under pressure of the apparent need for obtaining a supply of manganese for war uses, the Bureau of Mines constructed a pilot plant in 1941 to use the combined hand-picking and kiln-drying method. It was determined that although the kiln-drying section could produce nodules for a price, this would be uneconomical even under wartime conditions. At that time hand picking seemed about the only feasible low-cost method of separating the nodules of manganese from the shale. Estimated cost of production of nodules by hand picking in a plant designed to handle 20,000 tons of ore per day was $8.73 per ton of nodules, exclusive of amortization.

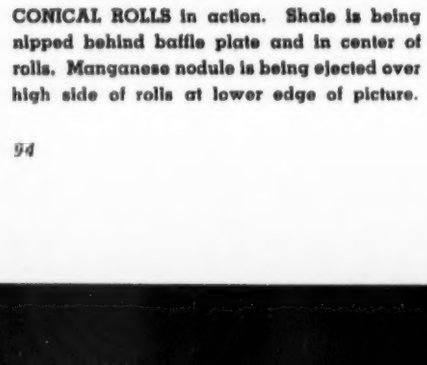
Subsequently, the Metals Reserve Co. employed the International Minerals & Chemical Corporation to prepare plans for a full-scale commercial plant that would produce 1,000 tons of nodules per day. International conducted tests at the Bureau's pilot plant near Chamberlain, S. D., and verified the results obtained by the Bureau. The organization also conducted some research pilot-plant work, using the Baum-type jig instead of the Harz-type jig that had been used in previous work by the Bureau. The Baum-type jig results were encouraging,[4] and plans were made by the Bureau to test the method further in a commercial-size jig. International's plans for constructing a full-scale production plant were not carried out, because the manganese situation had eased meanwhile.

[4]"South Dakota Manganese—A Reserve for the Future," by E. T. Casler and I. M. LeBaron. *Engineering and Mining Journal*, June, 1944.

The lowest cost that has previously been suggested was that worked out by International Minerals & Chemical Corporation wherein it estimated that on the basis of its tests with the laboratory-size Jeffrey Baum-type jig, a cost of $5.60 per short ton of nodules might be expected. International provided for a plant and equipment expenditure of about $5,500,000. The cost sheet in International's report provides for depreciation of plant and equipment but apparently not for return of the capital investment. International proposed to treat a minus-6-in. product in 3-cell Baum-type jigs.

Conical Rolls Tested

During the past year the Bureau of Mines has been continuing its study of the Missouri Valley manganese deposits with a view toward developing methods of mining and beneficiation that would produce manganiferous nodules from the Pierre shale at reasonable cost.



CONICAL ROLLS in action. Shale is being nipped behind baffle plate and in center of rolls. Manganese nodule is being ejected over high side of rolls at lower edge of picture.

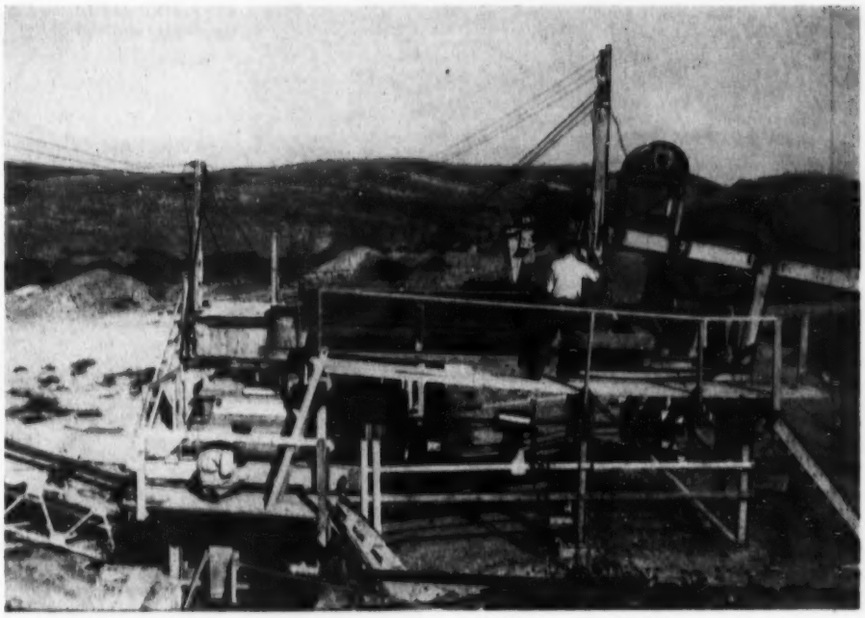
Estimated Costs Using Scrapers and Conical Rolls

Mining to use two tractors pulling 12-cu. yd. scrapers; third tractor to assist. ($34,000) Milling to use eight sets of conical rolls, four at each end of digging area. ($85,000)

	$ per ton of nodules
Operating cost, mining	0.75 (4½ per cu. yd.)
Operating cost, milling	0.63
Average past royalty	0.20
Overhead	0.20
Total operating cost	1.78
Depreciation, mining equipment	0.26 (In four years, 180 days each)
Depreciation, milling equipment	0.29 (In ten years)
Depreciation, total	0.55
Cost without amortization	2.33
Amortization in ten years	0.48
Cost plus amortization	2.81

In the clay industry conical rolls are common equipment. Customarily, conical rolls are used in conjunction with a granulator which cuts up compacted lumps of clay to prepare it for treatment in the rolls. The granulator consists of a series of knives mounted on a rotating shaft that acts as a device for cutting the clay and at the same time conveys the material through the machine.

The conical rolls consist of two truncated cones, the surfaces of which are parallel at the line of closest contact. The diameter at the small end of the truncated cones is 16 in. and at the large end 24 in. When clay is fed to the conical rolls, the clay passes through the rolls, and silica pebbles or other hard material ride the top of the opening between the rolls from the small-diameter end to the large-diameter end, thus effectively cleaning the clay.



MANGANESE TREATMENT PLANT includes only a granulator (center) and conical rolls (left). Granulator is not needed if scraper mining is used; conical rolls then separate the nodules. Contrast simplicity of this method with earlier testwork, which investigated possibilities of hand picking, explosive shattering, jigging, and chemical treatment.

Scissors-Like Action

The best conception of the action of conical rolls would be to compare them to a pair of scissors. If one tries to cut something too large or too hard for the capacity of the scissors, the object will be forced to the tip of the scissors without being cut. The same action takes place when conical rolls are used.

It was conceived by Bureau engineers that the bentonitic shale of the Chamberlain area might act similarly to clay, because it is a relatively soft shale having a consistency, when fresh, comparable to that of longhorn cheese. Preliminary experiments were made at the plant of the Washington Brick Co., Muirkirk, Md., in the fall of 1943, on a 5-ton sample shipment from Chamberlain. The tests were successful, and, based on the results obtained, a pilot plant using a granulator and a set of conical rolls was erected at the old site near Oacoma, S. D.

In the first series of operations with the granulator and conical rolls, all the ore was mined by a power shovel and was hauled by trucks to truck scales and thence to the ore bin. Three different types of roll shells were tried to determine the best combination that might be used. There were (1) smooth-surfaced; (2) screw-threaded surface, lands of threads $\frac{5}{8}$ in. wide at top and $\frac{3}{4}$ in. wide at base, space between threads, or groove, $1\frac{1}{2}$ in. wide at base, lands $\frac{1}{4}$ in. high; (3) spiral-grooved surface, smooth shell with spiral groove $\frac{5}{8}$ in. wide by $\frac{1}{4}$ in. deep, smooth distance along length of shell between groove 20 in. To date the best results have been obtained with the combination of one smooth shell and one spiral-grooved shell.

Several different roll shell speeds were tried with the different combinations of shells; a speed of 196 rpm. gave the best results. The granulator consumed about 45 hp. to cut the shale, and the rolls used approximately 15 hp.

When the granulator was used, maximum capacity was 25 tons hourly. Considerable difficulty was had with the granulator when surface-weathered, disintegrated, muddy shale was fed to it, because fine pieces of wet shale built up on the shaft. On the whole, the combination of granulator and conical rolls using power-shovel-mined material as feed was satisfactory, but it did require considerable labor to keep it going. If it should become advisable to use shovel-mined material only, it is believed that the mechanical difficulties can be overcome with comparative ease.

Carryall vs. Power Shovel

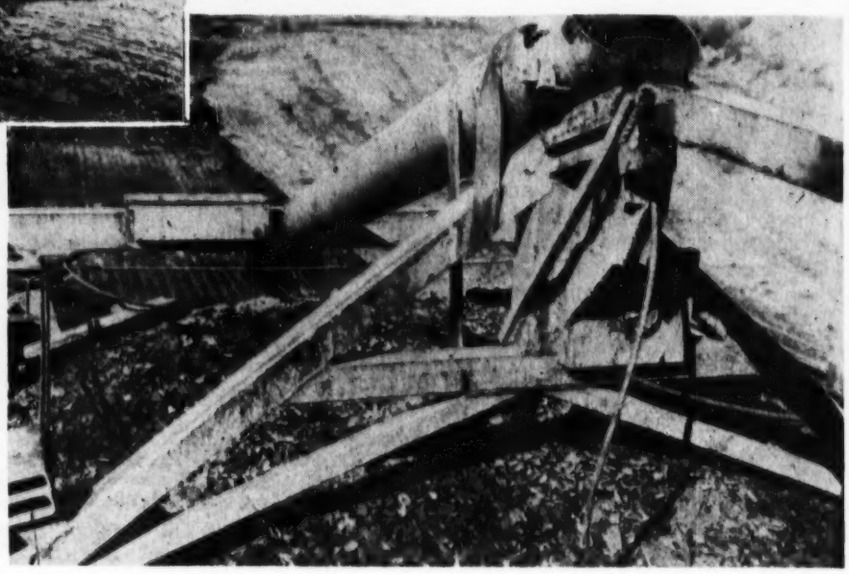
Gries and Rothrock had found that comparatively barren strata existed within the horizontal ore beds. Bureau of Mines men also observed that no matter how hard the shovel operator tried to take thin and small bites on the bank, he invariably got a large number of large chunks of fresh shale that caused some difficulty in the existing system, because the granulator capacity was insufficient to cut many of these large chunks into small pieces. In view of these observations it was decided to try mining with a scraper. Through the courtesy of the Indian Service at Fort Thompson, S. D., an Allis-Chalmers Model-L tractor, together with a 6-cu.yd. LeTourneau Carryall, was borrowed. The idea of using the Carryall was that it would take a smaller bite of the ore, and that layers of exceptionally low-grade material might be removed to waste directly.

It was found that the scraper not only took small bites but actually disintegrated the shale into small, platy pieces of approximately $\frac{1}{8}$ in. to $\frac{1}{4}$ in. in thickness and a maximum of 1 in. to $2\frac{1}{2}$ in. in other dimensions. Nodules were shucked out of the shale without material breakage. Using scraper mining, it became possible to bypass the granulator, saving 45 hp., and to feed the ore directly to the rolls. At the same time the feed capacity of the rolls was increased from 25 tons per hour to 39 tons per hour (natural or wet weight). The product was much cleaner and a much higher recovery was secured. Results of a typical test are given herewith. Further extensive tests are to be run during the 1946 spring season to secure added data upon which a commercial plant installation may be based.

From the results of the tests so far run it appears that scraper mining is successful only in the comparatively weathered portion of the deposits down to a depth of 3 to 6 ft. in which weathering has gone on for a number of years. At that point

SERRATED BLADE on Carryall was found most effective in breaking up shale while digging it in order to liberate manganese nodules.

CARRYALL LOAD OF SHALE. Note good fragmentation and platy character of shale. Larger pieces are manganese nodules, but only a few are visible.



unweathered nodules are encountered. Unweathered nodules are comparatively soft and friable, and when freshly exposed are usually of a consistency similar to sapolio.

Within a short time after exposure of the fresh unweathered nodule to air and sun, it becomes hard, gradually starts to oxidize, and goes through a series of color changes from dirty white through yellow and orange to black. Previous mineralogical studies of the nodules have been conducted largely in the laboratory, after the material had been exposed to the air for some time, which unfortunately resulted in some misconception of the actual characteristics of the nodules in place.

It was determined during the past winter that frost seems to effect the greatest weathering of the shale.

The relative hardness of the nodules will naturally affect materially the efficiency of any method of beneficiation. In previous mining by power shovel it was believed that soft nodules were a happenstance that could not be helped.

Weather Affects Mining

One pit was mined by scraper during the fall, down to soft, white nodules, to the point where no further economical separation of them could be secured and the scraper had difficulty excavating the compact unweathered material. Then, in about three months, frost had so penetrated as to condition the nodules for a foot or so and make it possible again to mine and liberate the nodules by means of the Carryall. The average annual frost depth is two to three feet; hence, a commercial operation based on scraper mining will of necessity operate over a comparatively wide area.

The milling method is so simple and includes so little equipment that the entire outfit—mill, bins, and conveyors—can easily be made mobile. The haulage distance can be kept to a minimum of but a few hundred feet if the mill is kept mobile.

From the work to date it appears that a comparatively small unit of operations upon which an infant industry may be based is entirely feasible. Two tractors, each hauling a 12-cu.yd. scraper, assisted by a third tractor equipped with angle-dozer blade, would provide all the mining equipment necessary to feed eight sets of conical rolls. The eight sets of rolls will produce an average of 180 tons of nodules per day at a concentration ratio of 25 to 1. The excavation equipment is adequate to provide for preparing roads, leveling off sites for roll installation, and other miscellaneous duties. The sets of rolls would be assembled in groups of four. One group would be placed at each end of the pit being mined, so that the scraper would never have an empty trip. Estimated costs are given in an accompanying table. The total cost, including amortization, would be $2.81; after amortization the total cost should be $2.33 per ton of nodules.

Such a small, low-cost operation, with its comparatively low capital investment, would probably be a feasible undertaking even under peacetime conditions, as it places the unit cost of manganese in the form of nodules at 17 to 18c. per short-ton unit of contained manganese (or 19c. to 20c. per long-ton unit).

Imported 48 percent manganese ore sold at Atlantic ports at an approximate average cost of 33.4c. per long-ton unit of manganese from 1935 to 1939 and 68.8c. from 1940 to 1944. Adding 11.2c. duty in each case gives an average cost to the consumer of 44.6c. and 80c., respectively, for the two periods. Such a price differential between imported and local supplies of ore would allow enough margin to bear considerable treatment cost in extracting manganese from the nodules.

At present the most attractive method of using Missouri Valley nodules appears to be in the manufacture of electrolytic manganese, especially considering the proposed power developments on the Missouri River. Electrolytic manganese has been successfully manufactured by the Bureau of Mines as well as by a private corporation for a number of years.

As the primary purpose of the Bureau's investigations of domestic sources of manganese is to make the Nation self-sufficient in time of national emergency, an extensive program is being carried out in cooperation with the steel industry to determine the usefulness and possible advantages of electrolytic manganese in the manufacture of steel. Extensive tests are also in progress on the use of electrolytic manganese in the non-ferrous metallurgy field. The result of these investigations, which thus far have been very encouraging, will be discussed later in separate reports.

How Hudson Bay Runs Its Mine Warehouse

P. G. BISHOP, Hudson Bay Mining and Smelting Co., Flin Flon, Man.

V. With the major duties of storekeeping, from receiving to issuing, dealt with in preceding installments, Mr. Bishop takes up the matters of inventory and filing, makes miscellaneous suggestions out of his experience that may help a newcomer save money and time, and concludes by discussing the qualifications that a good warehouse employee should have.

THE BEST METHOD of taking inventory for a fairly large stock appears to be the so-called perpetual inventory. One or more experienced men take a stock book and check the actual stock against the book balance, being careful to pick up daily issues and receipt items which may not yet be posted in the stock book. If a considerable difference between the count and the book figure becomes evident, all stock book entries since the time of the last or previous check should be thoroughly investigated.

When the difference is verified, debit or credit tickets are made to bring the stock book into line with actual stock on hand, and the stock page is dated with a dating stamp at point of check. Most of these adjustments are made to "inventory adjustment," which account is prorated to operating expense. If the item is used for only one operating account, it should be charged to it. All adjustment tickets have an "A" placed in front of the serial ticket number so they may be recognized in the stock book.

At the end of the year, or of any desired month, the stock balances are ruled off and multiplied by the price and extension shown. The totals of each class of material are taken off on an adding-machine tape and compared with the balances shown on statement of material receipts and issues (see Illustration 27 in Part IV, March, 1946). There will usually be some, nearly equal, overs and shorts, obviously due to summarizing materials to the wrong class during the year, and these differences will generally occur in classes adjoining each other. Otherwise, any large discrepancy should be fully investigated. *It has been possible to produce inventory totals in this manner year after year at Flin Flon with an error of a small fraction of 1 percent.* If on an inventory of over $1,000,000 you can come within a thousand dollars, it is proof that the past year's work has been quite accurate.

This system of inventory is undoubtedly easier to handle and more accurate and valuable than the old-fashioned way of trying to rush a count of all stock through in the last days of the year. The latter is inaccurate because you are rushed and have little time to investigate. Inexperienced help must be added to your force to get through in time, and many errors result. One of the worst features of a rush inventory is that the stock book is not corrected throughout the year, which means that it is little more than a price book. Using the perpetual inventory, everything is carefully checked once a year, and active stocks, likely to get out of balance, are gone over two or more times. It is unfortunate that the stock cannot be counted and balanced up every night, as money in a bank is.

As to Written Inventories

Written inventories may be produced from the stock book by typing the headings and figures after the book is extended at inventory time. Though an occasional written inventory may be of some use, it is doubtful. For one thing, the written inventory is largely obsolete by the time it is typed. The quantities are greatly changed during the month or six weeks needed in compiling the document and the cost of producing it will be high in comparison to any value obtained. Who ever gives a written inventory more than casual attention unless the stock is for sale? Much information is on the monthly statements, and details may be obtained at any time from the warehouse stock books.

Obsolete material should be noted and charged off to a special account if it cannot be used or sold. Before writing off or disposing of items which do not move, all departments should be canvassed for possible uses. It may even pay to write down the price to persuade cost-fearful operators to use material which is apparently obsolete. It is not good accounting to use the same account for inventory adjustments and write-offs of obsolete items, inasmuch as they are two different things.

Money-Saver Short-Cuts

There are a large number of ball and roller bearings, such as S.K.F., Hyatt, Timken, and so on, which are parts of various machines, such as motors, pumps, etc. The makers of the machines will show these bearings in their parts list under a part number of their own. If these are ordered by part number, the supplier will send you a bearing which he has obtained from some bearing manufacturer and usually make a profit all the way up to 100 percent.

Therefore, it pays to go through all the machinery stock and determine what the bearings really are and buy them directly from bearing makers. It may be found that one bearing is a part of several different machines. The stock-book page, therefore, for each bearing should

list all the various machinery which will use it. The stock-book pages covering the machine itself should show the machine maker's part number and a notation "Hyatt Bearing W-12," or whatever bearing it may be.

The bearings from each bearing manufacturer are all stocked together in one section.

Regarding babbitted bearings, you can cut down the quantity stock by having a few spares and rebabbitting old shells on a shop order and putting such bearings back in stock at the cost of the babbitting.

Contacts and Brushes

Manufacturers sell sets of contacts for various electric controllers, each set made up of several different contact pieces. As a rule an electric firm uses the same part number for identical contacts even though they fit several styles of controllers. So it pays to split up nearly all the sets of contacts into the various individual part numbers, taking care to note the various purposes the contact is used for on both the stock-marking and stock-book page. In many warehouses an attempt is made to carry sets of contacts for every device and sets will be robbed of certain contacts or a whole set will be drawn when only a few parts of such set are required. The warehouse is then cluttered up with partial sets, and confusion and money loss result.

For carbon brushes used in various electrical apparatus, a standard list of numbers, starting with number one, may be used. All the brushes are stored in number order in one place in the warehouse. A master list is made up, and after number one, for instance, full data as to maker's part number and apparatus which uses the brush is shown. Sometimes one brush will answer for more than one device. The electrical department has a copy of the master list and sends a withdrawal requisition showing the master number.

Water and air tubes for various types of rock drills can be made from steel tubing in your own shop for about a third of the prices at which you can buy them. However, the making of parts for any machinery should be thoroughly studied before going into it, as, generally speaking, the making of so-called "bootleg" parts does not pay.

Such material as bars and sheets of steel are best carried by using the price and issue units of lineal feet for bars and square feet for sheets or plates. Though such items are bought by weight, the use of feet in stocking is quite accurate and saves a great deal of time and labor required in weighing.

POINTS ABOUT FILING

The following filing system is suggested for warehouses of some size:

1. All receiving papers and correspondence pertaining to a particular purchase order are firmly attached to it and filed in numerical order in letter-size filing cases. Files built up of drawers which may be moved about are the best.

2. Purchase requisitions with papers pertaining to them are filed together in number order.

3. Correspondence relating to material not covered by requisition or order is filed according to material classification in folders marked with the class letters. For instance, matters pertaining to laboratory supplies would be put in a file marked "Class A." Each class file may be further subdivided as desirable.

4. Freight and express bills are filed in bundles by month, being arranged in freight-bill or express-bill number order and each bundle marked with the month and year. Bills of lading covering shipments sent out by the warehouse are numbered consecutively and each one is indexed by placing the number on a card bearing the consignee's name. Copies of the bills of lading are filed numerically.

5. Catalogs are card-indexed on two sets of cards, one carrying the firm names and catalog numbers assigned to them, and the other set a general description of material under which suppliers and catalog numbers are listed.

6. Pamphlets advertising material are numbered and indexed on the same card as catalogs, with the letter "P" prefixed to the number and filed in filing cases carrying folders marked with the material class letters.

Business registers showing important manufacturers and products in your own and foreign countries are a valuable adjunct to your catalog file. Recent telephone directories of the larger nearby cities are useful; also a good dictionary.

7. Parts lists for apparatus used in the plant are marked and numbered with their own series of numbers and filed separately. All parts list numbers are indicated on a fly-leaf page in the stock books at the head of each machine.

A few other files may be arranged to suit special requirements and a list should be maintained describing all files. It is wise to get a receipt and keep a record of any important catalog or document loaned from the warehouse.

Containers a Problem

A large warehouse will have a problem of accounting for and obtaining credits on several kinds of containers which suppliers charge for and will credit when returned. In the first place, these containers, such as steel drums, reels for wire cable, and the like, should be taken up as part of the cost covering the material received. You cannot be sure of getting them back from the plant, and if containers are carried as a separate stock item the warehouse will have to write off a considerable number which are destroyed or lost.

A simple way of handling containers is to keep a record book in which each shipper's containers are listed

as to date received, weight, serial number, if any, and a warehouse number which is painted on the container. The purchase order number is also recorded, and when return shipment is made the date of return and bill of lading number are entered. There should be a column for each item of the information specified in the foregoing.

When returns are made, a letter is written to the consignee giving full particulars and inclosing a copy of the bill of lading. Copies of this correspondence are sent to the purchasing department and further copies are placed in the credit file—the "dope box." Credits, when received, are best credited to a special account and prorated monthly over the entire operation. An attempt to credit individual operating accounts involves more work than it is worth, although exception may be made on operating accounts receiving a large number of containers applicable to a single operation.

The warehouse should frequently trace on departments for delivery of empty containers and spend considerable effort in retrieving them from the plant. It is often practicable to ship mixed carlots of containers to some forwarding company for distribution to various suppliers from a central point.

Dummy orders, preferably numbered with even numbers, are made up and indexed to take care of shipping and credit papers for each supplier. Dummy orders may be used for this purpose or other purposes and are numbered as "D-5000."

Build Good Will

The relations between the stores department and other departments of the plant should be cordial. The warehouse ought to deal with other departments with the same good will and patience a good merchandise concern uses with its customers. Frequent visits by the storekeeper to heads of departments to see how material actually is used; to suggest use of cheaper material if it will answer; and obtain advance information on proposed new work are of great value. Complaints on material or warehouse practice may be discussed and clarified during visits with operators. Operators, on the other hand, should call frequently at the warehouse and look over stocks which may be used for special work. Purchase of new material may often be avoided if operators are familiar with warehouse stock.

Another good idea is for various departments to maintain a standard list of vital items and make monthly checks of stocks of such items on hand or on order. This is especially valuable if the plant is a long distance from the market, as in South America, or any other location requiring orders far in advance of delivery.

Supplies Mean Money

Sometimes it is hard to make operators "material conscious." Cash is locked up, overtime is watched closely, but material is allowed to lie about as if it were worthless. Any employee will pick up a dollar bill quickly enough, but parts of kegs of nails, bolts, and other material will be out in the rain for months. There is a story that a former famous copper magnate at Butte, Mont., would stand and yell if he found a few nails on the ground until someone came and picked them up. This may have been extreme, but he was on the right track. It might even be helpful to post signs around a plant to remind employees that wastefulness can create shortages of vitally needed items. Though it is true in the mining business that the quicker the ore is mined the greater the profit, the haste involved in no way justifies waste or careless usage of the materials required.

Material left over from construction should be cleaned up at the conclusion of or during the job, and returned to the warehouse. The warehouse should credit all standard stock items to the proper account. Items which are special and of no probable future use are best taken back at no cost and returned to the supplier for credit, if possible, or sold or scrapped. You might call such items "engineers' mistakes." There is no sense in increasing the inventory with such items just to keep the cost of some job down to the estimate. There are laws governing corporations that require that inventories consist of useful material. See that this rule is observed. Possibly much waste might be avoided if companies shared salvage profits with employees, but this is open to doubt. It is, indeed, difficult to get the idea over to employees that supplies cost money.

The management of a mine should, if policy permits, give the storekeeper an outline of the proposed heavy construction or operation repairs generally anticipated for one year. This is a great help in seeing that ordinary stocks are carried in sufficient quantities to take care of such special work in addition to the usual routine operation.

What qualifications should a good warehouse employee have? Warehousemen are often somewhat older at the start than those hired for other operations. They may be former mechanics or operators from the plant who for lack of strength cannot stand excessive physical work but who have acquired a working knowledge of considerable material. Men with hardware experience and some of mechanical bent will adapt themselves more easily than others to warehouse work. Previous work in a merchandise store is helpful, and a reputation and record of strict honesty are essential.

In training new workers, it is usually better to start them at the bottom in cleaning up premises, trucking freight, and other odd jobs. The next steps are checking and storing incoming goods, issuing material, and later the job of head receiving clerk, foreman, or storekeeper. Office help taken from the outside warehouse crew have a great advantage over those lacking such experience, if they can learn office work. Otherwise, if clerical help without previous warehouse experience is taken on, it is a good idea to put them outside in stockroom work for a period of six months or longer if necessary.

Working Up From Bottom

A storekeeper is much better equipped if he has worked up from the bottom. Such a man acquires a kind of sixth sense which warns him if stock runs low or anything goes wrong, even if nothing in particular calls the matter to his attention. To use a slang expression: a good storekeeper knows all the answers, or a lot of them, but he often becomes a pessimist. He sees only the expense side of the business. Warehouse work should be done with the same precision with which a bank handles money.

In conclusion, we might say that a good warehouse system consists of checks and balances such as many of us think a good government should have. Records of nearly everything are valuable, because a large stock is something that cannot be carried in the head to any great extent.

A good stock book is the main foundation of successful stores operation. The time comes when the mine is exhausted and stock and equipment must be sold. Then, the stock book can lead you to your invoice and freight bill and give the cost, age, and source of supply—all the details helpful in disposing of the material.

MARKET SUMMARY

WORK STOPPAGES IN THE non-ferrous metals industry became so widespread before March ended that business could be conducted only on a greatly reduced scale, particularly in copper and lead. The task of supplying consumers of copper with proper shapes became most involved. Consumers began to feel the growing dearth in supplies that threatens to restrict production in key industries. Compared with copper and lead, the zinc producers so far have suffered only minor dislocations. Secretary of Labor Schwellenbach named a fact-finding board late in March to report on the wage disputes, and there was hope in official circles that an agreement will be reached within 30 days.

To meet the demands of labor, most observers contend that higher prices for metals will have to be sanctioned. However, late in March, Chester Bowles, Director of Economic Stabilization, announced that the Premium Price Plan has been modified to take care of increased costs. This step was agreed upon by the CPA, RFC, and OPA. The revised plan provides for (1) reduced quotas; (2) additional premium ranges, as much as 2½c. for lead, and a special copper quota with premium payments not to exceed 10c. per pound; (3) premium payments to mines whose costs previously excluded them from the plan.

Owing to labor difficulties, production of refined copper in the United States declined from 69,008 tons in January to 43,584 tons in February. Deliveries to consumers declined from 115,601 tons in January to 84,716 tons in February. Actual consumption of refined copper by fabricators dropped to 71,034 tons in February, against 100,213 tons in the preceding month.

Though "bulk" buying of foreign copper by governments is likely to continue for some time, the volume of business transacted daily in foreign copper in the free market has been expanding since the beginning of the year. This volume has attained proportions that again make it possible to establish a quotation that can be accepted as a measure of value for copper sold outside of the United States. Effective March 14, our export quotation for copper reflects prices obtained by foreign producers in the open market.

After long negotiations, RFC has agreed to purchase about 120,000 tons of South American copper announced early this year at approximately the "world price," equivalent to 11.875c., f.a.s. port of shipment.

Major Metals

U. S. DAILY AND AVERAGE PRICES

	Electrolytic Copper		Straits Tin	Lead		Zinc
1946 Mar.	Domestic (a) Refinery	Export (b) Refinery	New York	New York	St. Louis	St. Louis
1	11.775	11.700	52.000	6.50	6.35	8.25
2	11.775	11.700	52.000	6.50	6.35	8.25
4	11.775	11.700	52.000	6.50	6.35	8.25
5	11.775	11.700	52.000	6.50	6.35	8.25
6	11.775	11.700	52.000	6.50	6.35	8.25
7	11.775	11.700	52.000	6.50	6.35	8.25
8	11.775	11.700	52.000	6.50	6.35	8.25
9	11.775	11.700	52.000	6.50	6.35	8.25
11	11.775	11.700	52.000	6.50	6.35	8.25
12	11.775	11.700	52.000	6.50	6.35	8.25
13	11.775	11.700	52.000	6.50	6.35	8.25
14	11.775	11.925	52.000	6.50	6.35	8.25
15	11.775	11.975	52.000	6.50	6.35	8.25
16	11.775	11.925	52.000	6.50	6.35	8.25
18	11.775	11.950	52.000	6.50	6.35	8.25
19	11.775	11.950	52.000	6.50	6.35	8.25
20	11.775	11.925	52.000	6.50	6.35	8.25
21	11.775	11.975	52.000	6.50	6.35	8.25
22	11.775	11.925	52.000	6.50	6.35	8.25
23	11.775	12.050	52.000	6.50	6.35	8.25
25	11.775	11.925	52.000	6.50	6.35	8.25
26	11.775	11.925	52.000	6.50	6.35	8.25
27	11.775	11.925	52.000	6.50	6.35	8.25
28	11.775	11.975	52.000	6.50	6.35	8.25
29	11.775	11.925	52.000	6.50	6.35	8.25
30	11.775	11.925	52.000	6.50	6.35	8.25
AVERAGES FOR MONTH						
Mar.	11.775	11.842	52.000	6.50	6.35	8.25
AVERAGES FOR WEEK						
6	11.775	11.700	52.000	6.50	6.35	8.25
13	11.775	11.700	52.000	6.50	6.35	8.25
20	11.775	11.942	52.000	6.50	6.35	8.25
27	11.775	11.954	52.000	6.50	6.35	8.25
CALENDAR WEEK AVERAGES						
Mar. 2	11.775	11.700	52.000	6.50	6.35	8.25
9	11.775	11.700	52.000	6.50	6.35	8.25
16	11.775	11.821	52.000	6.50	6.35	8.25
23	11.775	11.963	52.000	6.50	6.35	8.25
30	11.775	11.933	52.000	6.50	6.35	8.25

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

Effective March 14, our export quotation for copper reflects prices obtaining in the open market and is based on sales in the foreign market reduced to the f.o.b. refinery equivalent, Atlantic seaboard. On f.a.s. transactions we deduct 0.075c. for lighterage, etc., to arrive at the f.o.b. refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead.

(c) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c. per troy ounce. Handy & Harman's quotation on newly-mined domestic silver 999 fine was 70⅝c. throughout March.

London silver in pence per troy ounce.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

	Sterling Exchange	Silver		Gold	
1946 Mar.	"Checks"	(c) New York	London	London	(d) United States
1	403.000	70.750	44d.	172s. 3d.	$35.000
2	403.000	(e)	(e)	(e)	35.000
4	403.000	70.750	44d.	172s. 3d.	35.000
5	403.000	70.750	44d.	172s. 3d.	35.000
6	403.000	70.750	44d.	172s. 3d.	35.000
7	403.000	70.750	44d.	172s. 3d.	35.000
8	403.000	70.750	44d.	172s. 3d.	35.000
9	403.000	(e)	(e)	(e)	35.000
11	403.000	70.750	44d.	172s. 3d.	35.000
12	403.000	70.750	44d.	172s. 3d.	35.000
13	403.000	70.750	44d.	172s. 3d.	35.000
14	403.000	70.750	44d.	172s. 3d.	35.000
15	403.000	70.750	44d.	172s. 3d.	35.000
16	403.000	(e)	(e)	(e)	35.000
18	403.000	70.750	44d.	172s. 3d.	35.000
19	403.000	70.750	44d.	172s. 3d.	35.000
20	403.250	70.750	44d.	172s. 3d.	35.000
21	403.250	70.750	44d.	172s. 3d.	35.000
22	403.250	70.750	44d.	172s. 3d.	35.000
23	403.250	(e)	(e)	(e)	35.000
25	403.250	70.750	44d.	172s. 3d.	35.000
26	403.250	70.750	44d.	172s. 3d.	35.000
27	403.250	70.750	44d.	172s. 3d.	35.000
28	403.250	70.750	44d.	172s. 3d.	35.000
29	403.250	70.750	44d.	172s. 3d.	35.000
30	403.250	(e)	(e)	(e)	35.000
AVERAGES FOR MONTH					
Mar.	403.096	70.750	—		
AVERAGES FOR WEEK					
6	403.000	70.750	—		
13	403.000	70.750	—		
20	403.042	70.750	—		
27	403.250	70.750	—		

Calendar week averages, New York Silver: Mar. 2nd, 70.750; 9th, 70.750; 16th, 70.750; 23rd, 70.750; 30th, 70.750.

(e) Not quoted (Saturday).

Strikes reduced domestic production of lead to about one-half of the tonnage that was available earlier in the year. To make matters worse, imports have dropped and the stockpile has been reduced to the minimum. Consumers asked for some 30,000 tons of foreign lead for April, but may not obtain much more than 6,000 tons. Consumption will be curtailed in pigments, tetraethyl, and other lines. Until the labor situation improves, supplies will fall far short of even the restricted consumption allowed by CPA. The foreign market for lead has been rising and additional purchases by the Government will probably be made at higher than 7c. per pound. Disappointment among producers over the stand taken by OPA to maintain a 6½c. market here continues.

Settlement of the strike in the steel industry has been followed by an active demand for Prime Western zinc for galvanizing.

A special "CC" rating now is available to obtain cadmium needed for essential purposes. Quicksilver was higher on reduced offerings of spot and nearby metal.

Miscellaneous Metals Monthly Averages

Average prices of miscellaneous metals for February and March.

(a) New York, packed in cases, in lots of 5 tons or more but less than a carload. (b) Nominal. (c) Producer's price for commercial sticks. (d) Average producers' and platers' quotations. (e) Special shapes sold to platers.

	Feb.	March
Quicksilver, N. Y. flask	102.727	103.923
Antimony (a)	15.839	15.839
Antimony, bulk, Laredo	14.500	14.500
Antimony, bulk, N. Y.	15.265	15.265
Antimony, Chinese (b)	16.500	16.500
Platinum, oz. troy	35.000	35.000
Cadmium (c)	90.000	90.000
Cadmium (d)	92.500	92.500
Cadmium (e)	95.000	95.000
Aluminum ingot	15.000	15.000

E & M J Price Index

Weighted index of non-ferrous metal prices (copper, lead, zinc, tin, silver, nickel, and aluminum). The average for the years 1922-1923-1924 equals 100.

1929	110.33	1937	90.86
1930	82.87	1938	73.67
1931	60.20	1939	77.71
1932	48.26	1940	79.22
1933	59.79	1941	83.49
1934	65.59	1942	86.80
1935	74.66	1943	88.74
1936	73.45	1944	88.74
		1945	90.86

	1944	1945	1946
January	88.74	88.74	96.42
February	88.74	88.74	96.42
March	88.74	88.74	96.42
April	88.74	88.74	....
May	88.74	88.74	....
June	88.74	88.74	....
July	88.74	88.74	....
August	88.74	88.74	....
September	88.74	91.16	....
October	88.74	96.40	....
November	88.74	96.42	....
December	88.74	96.42	....

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

MISCELLANEOUS METALS

(April 1, 1946)

Aluminum, ingot, 99 plus per cent, lb.	15c.
Antimony, domestic, spot, lb., 5 tons or more	15.839c.
Bismuth, ton lots, lb.	$1.25
Cadmium, commercial sticks, lb.	90c.
Calcium, lb., ton lots, 97 @ 98 per cent, cast	$1.85
Chromium, 97 per cent grade, lb.	89c.
Cobalt, 97 to 99 per cent, per lb.	$1.50
Indium, troy oz.	$2.25
Nickel, electrolytic cathodes, lb.	35c.
Magnesium, 99.8 per cent, carloads, lb.	20½c.
Palladium, troy oz.	$24.00
Platinum (Official quotation) troy oz.	$35.00
Quicksilver, flask of 76 lb., 25 flasks or more	$104.00
Selenium, 99.5 per cent, lb.	$1.75
Silicon, minimum 97 per cent, spot, carloads, lb.	14.75c.
Tellurium, lb.	$1.75 nom.
Thallium, 100 lb. or more, lb.	$12.50 nom.
Titanium, 96 to 98 per cent, lb.	$5.00

METALLIC ORES

Beryllium Ore, 8 to 12% BeO, f.o.b. mine, per unit	$8.00@$10.00
Chrome Ore, per long ton, f.o.b. cars Atl. ports, dry 48% Cr_2O_3, 2.8 to 1 ratio (Prices nominal)	$41.00
48% Cr_2O_3 3 to 1 ratio	$43.50
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$4.95
Mesabi bessemer	$4.70
Old Range non-bessemer	$4.80
Mesabi, non-bessemer	$4.55
Lead (Galena) 80 per cent, Joplin, Mo., ton	$76.01
Manganese, Metals Reserve Co. sales price, per long-ton unit of Mn contained, 48 per cent, subject to premiums and penalties, effective May 15, 1944: 85c. (duty paid) New York, Philadelphia, Baltimore, Norfolk, Mobile, and New Orleans; 91c., Fontana, Calif., Provo, Utah, and Pueblo, Colo. (Prices nominal)	
Molybdenum Ore, 90%, per lb. of MoS_2 f.o.b. mines	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 60 per cent, duty paid	$24.00
Domestic, 60 per cent and upward	$24.00
Vanadium Ore, per lb. of contained V_2O_5 f.o.b. mines	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton. (a) Prices at mines, small lots, normally several dollars less.	$50.00

METALLIC COMPOUNDS

Arsenic Oxide (arsenic) lb.	4c.
Cobalt Oxide, 70 @ 71 per cent, lb.	$1.06
Copper Sulphate, 100 lb.	$5.00

ALLOYS

Beryllium Copper, 2.5 to 3 per cent Be, per lb. of contained Be	$15.00
Ferrochrome, 65 @ 70 per cent per lb. of Cr contained	13c.
Ferromanganese, 78 @ 82 per cent, gross ton	$135.00
Ferromolybdenum, 55 @ 65 per cent Mo, lb. of Mo contained	95c.
Ferrosilicon, 50 per cent, per lb. of contained Si	6.60@8.10c.
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$1.90
Ferrovanadium, per lb. of V delivered	$2.70@$2.90
Silicomanganese, 1 per cent C, gross ton	$138.00

NON-METALLIC MINERALS

Asbestos, f.o.b. Canadian (Quebec) mines (U. S. funds), ton:	
Crude No. 1	$650@$758
Crude No. 2	$165@$385
Spinning fibers	$124@$233
Paper stock	$44@$49.50
Shorts	$14.50@$26.50
Vermont, f.o.b. Hyde Park:	
Shingle stock	$62.50@$65.00
Paper stock	$44.00@$53.00
Shorts	$14.50@$28.50
Floats	$19.50
Barytes, f.o.b. mines:	
Georgia, crude, per long ton	$8.50@$9.00
Missouri, 93 to 94 per cent $BaSO_4$, per short ton	$8.25@$8.50
Bauxite, long ton:	
Domestic, crude, 50 @ 52 per cent (not dried)	$5.00
Domestic, chemical, 55 @ 58 per cent	$7.50@$8.50
Domestic, abrasive, 80 @ 84 per cent	$16.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$15.00
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 60 per cent, all rail movement, ton	$30.00
Acid 98 and 1 per cent, bulk, ton	$37.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton dead-burned, f.o.b. Washington	$22.00
Mica — Colonial Mica Corp., agent for Metals Reserve Co., quoted full-trimmed ruby muscovite domestic, April 1 to Sept. 30, inclusive — No. 1, $1.70 to $36.65 per lb., depending on size; No. 2, $1.25 to $26.00; No. 2 Inferior, 50c. to $16.00; No. 3, 25c. to $6.25. Prices f.o.b. nearest producer's rifting plant. Current quotations nominal.	
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c i f. Atlantic ports	12c. nom.
Silica, in bags, 325 mesh, ton	$20.00@$40.00
Sulphur, Texas, mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
Vermont, extra white, 200 mesh	$9.50@$10.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton: Basic	$26.00
Steel, base price, Pittsburgh Billets, gross ton	$39.00
Structural shapes, 100 lb.	$2.35

WASHINGTON REFLECTIONS

McGRAW-HILL WASHINGTON NEWS BUREAU

Krug Promises Merit Basis For Interior Department

After 13 years of guidance by the "old curmudgeon," the Department of the Interior began to function under new direction on March 18, when Julius A. Krug was sworn in as the 33d secretary. President Truman announced the nomination of the former head of WPB at a press conference Feb. 28. The Senate confirmed the nomination unanimously on March 5.

That there will be changes in the administration of the department under the new secretary is a foregone conclusion. However, there were no indications of what modifications were to be put into effect by Mr. Krug prior to his installation except what could be gleaned from his testimony before the Senate Committee on Public Lands and Surveys, which considered his nomination. Besides demonstrating that he can get on with Congress, Mr. Krug under senatorial questioning gave a clear explanation of his thinking on several broad questions of policy.

Mr. Krug's ideas on Government control over the national economy were brought out by Senator O'Mahoney. The record of their questions and answers reads in part as follows:

Senator O'Mahoney: "You said WPB was liquidated at your suggestion."

Mr. Krug: "Yes, sir."

Senator O'Mahoney: "Perhaps you might develop that thought, particularly with respect to the lifting of controls—when you began to lift controls—and what your policy was with respect to controls."

Mr. Krug: "I will be pleased to answer that, Senator.

"It was always the policy of WPB to impose only such controls as were needed in the war or in the transition from war to peace and to lift them as soon as no longer needed.

"It was quite clear in the late summer of 1945 that controls on materials would not help, but would hinder, reconversion.

"I might say that I am still firmly of that point of view.

"The suggestion was made in a number of places that WPB lifted controls too fast. I don't believe that. I haven't been able to find anyone that can point to a single control that would have aided in the predicament that has happened to confound the country's economy during the last three months.

"I think all wartime controls must be lifted when they have served their purpose. I don't mean by that for an instant that price controls should be lifted, except in those fields where they have served their purpose. I think the confusion, if there has been any, comes from not deciding realistically on those controls which are needed, and those controls which are no longer needed.

—Reni photo

JULIUS A. ("CAP") KRUG being sworn in as Secretary of the Interior by Supreme Court Associate Justice Wiley Rutledge.

"I think you know that the controls that were needed in WPB have been continued. I point to controls on tin, crude rubber, and things like that; they remain in short supply.

"But controls over aluminum, magnesium, and many chemicals no longer in short supply were abolished, and I am quite certain that that was a sound course of action."

For Free Economy

Senator O'Mahoney: "Then would it be proper to say that your philosophy with respect to WPB was to allow the economy to operate as freely as possible and as rapidly as possible?"

Mr. Krug: "Yes, sir."

Senator O'Mahoney: "Would it be proper for me to ask you, whether you would continue that philosophy in the Department of the Interior? I ask that, having in mind particularly the desire of the people who live in the public-land states to be as free as possible from Government controls."

Mr. Krug: "Well, these generalities are hard to make concrete, but I must say I believe in the philosophy that the best government is the least government, and on top of that, the closer you can get to the people the better off you are.

"I might say, while this might not sound exciting to you gentlemen, that I hope, if I am confirmed for this post, to conduct the activities of the department with that in mind, regardless of what it means to the department itself.

"I think there is too much going on in Washington having to do with one department's prerogative, rather than looking at the whole picture and deciding how the job should be done and where, in the interest of the people.

"I followed the practice, during my period with WPB, of getting out with the people who were doing the job, and we decentralized our operation to where we had as many people in the field as we had in Washington.

"As a matter of fact, I think we had about a thousand more in the field than we had in Washington. It was effective, because we got to know the problems of the various sections of the country and the people got to know us, so we weren't just some Government name or Government directive; we were men trying to work with other men on the problems of the day."

Senator McCarran questioned Mr. Krug on his mining and agricultural experience. Said Senator McCarran, "I am very anxious to know what, if any, experience you have had with mining or with agricultural pursuits as they are carried on in the open and public domain."

Mr. Krug: "Senator, I wish I could tell you that I know at this moment all about the problems of the Department of the Interior."

Senator McCarran: "Well, I wouldn't believe you if you did." (Laughter.)

Mr. Krug: "I can't say that I know all about even the most important problems. I think the most I can say is this: I have had considerable dealings with some of the bureaus of the De-

partment of the Interior. During my period in WPB we had extensive dealings with the Petroleum Administration for War, the Solid Fuels Administration, and the Bureau of Mines. We also had a close relationship with the Bureau of Reclamation and with the Bonneville Power Administration. Accordingly, I did get to know something about their problems.

To Study West's Problems

"I have traveled considerably in the West, before and during the war, and I know about some of the great projects of the Department of the Interior.

"I have visited Boulder Dam, and the Central Valley project, including Shasta and Friant dams. I have been up through the Northwest, Bonneville and Grand Coulee. I visited Denver and talked with the mining people during the war when we had some quite critical shortages, in an effort to deal with their problems.

"But I am humble when I look at the present vast responsibilities of the department with respect to public lands. I have a lot to learn in that field. All I can tell you is that I think I have a deep and sincere interest in public service and in the public interest in it; I have a reasonable amount of energy and vitality; I have a very profound respect for our democracy, because I am sure it works. That dates not only from WPB but from my experience before that.

"And, if I go into this position, I will do my best to get to understand the problems of the Interior and apply what common sense I have to their fair solution in the interest of the people of the areas affected."

On the subject of mine development, Senator McCarran asked, "Mr. Krug, have you any policy at this time or any fixed idea with reference to the development of mines in the United States? Should the policy be pursued, for instance, of closing our mines, so far as development is concerned, and bringing minerals in from abroad?"

Mr. Krug: "I don't think I can give you any general answer to that question, Senator McCarran.

For Maximum Development

"I feel that our mineral wealth is one of our greatest resources, and that we should have a program, and a definite and intelligent one, to get the maximum development of our mineral resources for the future of our country.

"In specific cases, I am sure you may have to import minerals in order to bring the supply up to what is needed to do the job. That is obviously the case in tin, where we have tried for years to get a domestic supply that was usable, without being able to do so."

The Chairman: "I will talk with you about tin in New Mexico sometime."

Senator McCarran: "That is one point where we have an absolute lack of the mineral, but where we have the minerals there has been a declared policy in the past of closing our own mining in the United States and bringing the minerals in from abroad. I wanted to know if you had any preconceived idea on that."

Mr. Krug: "I do not have any preconceived ideas along that line."

At the induction ceremony, Secretary Krug restated three administrative fundamentals which he will use in handling the affairs of the department:

1. "The department will operate as a single going concern through the teamwork of its bureaus and agencies."

2. "The activities and functions of the department will be discharged, delegated or redistributed, to produce the best results for the people of the country. The department's prestige or the prestige of its executives will not be permitted to confuse the issue of how the job can best be done."

Merit Is Criterion

3. "Merit, competency, and devotion to public service will provide the criteria for employment or advancement. Government action will be resorted to only when public purposes cannot otherwise be accomplished, but in such cases the department will carry out the mandate of the Congress without fear or compromise with private interests seeking to obstruct necessary action."

In spite of Mr. Krug's long experience as a Government administrator, in assuming the top job in the Department of the Interior he is for the first time going up against entrenched bureaucracy as it is found only in the old-line agencies. The meeting is likely to have interesting repercussions.

McCarran Offers Compromise on Silver Price

New episodes occurred during March in the congressional battle over the Government price of silver. In October, Senator Green had filed a bill to renew the Green Act, which expired Dec. 31. This Act provided for continued selling of Treasury "free" silver at $0.7111. Senator McCarran countered with a bill that would raise the purchase price to $1.29 (*E. & M. J.*, Nov., p. 108). Both bills were stymied in committee.

Early in March Senator Green succeeded in getting his legislation approved by the House as a rider to the Treasury-Post Office appropriation bill. This bill is now before the Senate Committee on Appropriations, but the amendment is likely to be deleted because it is not germane to the main purposes of the legislation.

Meanwhile, late in March, Senator McCarran introduced another bill, intended as a compromise. This bill, now before the Senate Committee on Banking and Currency, provides for one year's sale of Treasury "free" silver at $1.0343 to purchasers who have made reasonable efforts to satisfy their needs elsewhere. After one year it provides for the price to be raised to $1.29. The prices given are intended to apply both to sales and to Government purchases from silver producers.

OPA Holds Non-Ferrous Prices; Lets Premiums Expand

Despite rising metal prices elsewhere in the world, and in the face of its own action in the steel case, OPA has decided to try to meet prospective wage increases in non-ferrous mining by raising premiums instead of prices. (See p. 104.) This move, if accepted by industry, is unquestionably toward increased Governmental control over industry, because it would bring even low-cost producers under OPA's wing and increase the dependence of high-cost mines on the mothering agency.

Persons familiar with the industry feel that premium increases will give no real impetus to non-ferrous metal output. Chief reason is the uncertainty in a producer's mind as to the operating margin left him after it has been squeezed between militant unionists and OPA economists. OPA reassurances on this point leave the producer cold. The Government is getting deeper in his business than it was in wartime, and he doesn't like it.

Spence Bill Faces Revision or Defeat Account OPA Zeal

A more rapid tempo could be noted in the actions of Congress during late March and early April, as an early and prolonged summer recess became a possibility. Under the circumstances, Washington observers expected that the Spence bill (H.R. 5270) would be reported out of committee with a favorable report, without regard to the testimony. On the floor of the House there will be a fight, and the extension of the Emergency Price Control Act could be defeated. If it passes, the probabilities are for many restrictions not included in the committee version.

From a practical standpoint, many of the irritating ceiling prices could have been removed long ago except for the zeal of Chester Bowles.

Blanket Restriction Lifted on Location of Mineral Deposits

In early March the Government, by Executive Order, relaxed the blanket restrictions of last September on the use of public lands pending determination of the location and extent of radioactive minerals in the lands.

Spokesmen for the Department of the Interior explained "that if the first withdrawal order was modified to insure Government control over substantial amounts of fissionable materials—rather than traces of radioactive substances—adequate safeguards would be provided for the United States in atomic energy development."

The Executive Order of March 4 extended the broader opportunities for the use of public lands to lands acquired by other agencies of the Government besides those under the control of the Department of the Interior.

Legislation is under consideration which would reserve to the United States title to all fissible materials.

NEWS OF THE INDUSTRY

Bowles Backs Subsidies To Offset Higher Wages

Chester Bowles, Director of Economic Stabilization, announced on March 28 that cost increases resulting from wage adjustments in non-ferrous mining will not affect ceiling prices for copper, lead, and zinc but will be met through increased subsidy payments under the Government's Premium Price Plan. This was considered the most feasible method of preventing increases of non-ferrous metal prices which might result in further price spirals in the fabricating and manufacturing industries.

The Office of Economic Stabilization, the Office of Price Administration, and the Civilian Production Administration announce that with respect to wage increases approved by the Wage Stabilization Board in the copper, lead, and zinc mining, smelting, and refining industries, the Premium Price Plan will be employed to provide necessary price adjustments. The terms of such adjustments and of modifications in the plan to enable these adjustments are set forth below. Present legislation provides for operation of the plan until June 30, 1946. Legislation for its continuance is now pending before both houses of Congress. Premium payments will continue to be functioned by Reconstruction Finance Corporation through its Office of Metals Reserve.

1. For a mine with higher operating costs after current wage increases than the lowest costs now recognized by the Quota Committee as bases for quota revisions (provided the present operating margin is not in excess of that allowed for by the Quota Committee in calculating quotas), the Quota Committee will upon application assign a revised quota within the limits of present premium ranges or the limits of those established by this release, which shall be calculated to give no diminution of margin as a result of current wage increases.

2. For a mine with lower operating costs after current wage increases than the lowest costs now recognized by the Quota Committee as bases for quota revisions, the Quota Committee will upon application assign a revised quota calculated to yield an operating margin per pound of metal not less than the margin for the period 1936-39, inclusive, provided there has been no substantial change in the grade of ore mined. For any such mine in which the grade of ore mined has changed substantially or as to which 1936-39 operations were not comparable to present operations, a quota will be assigned calculated to yield a margin not less than would have been earned in 1936-39 on the basis of present grades of ore mined and present operations adjusted to 1936-39 cost levels.

3. Such revisions will be made effective as of the effective dates of the wage increases.

4. As future operating costs at any mine change upward or downward, its quota will be calculated either on the basis of the cost-margin criteria employed by the Quota Committee as modified by Paragraph 1 above or on the 1936-39 basis as set forth in Paragraph 2 above, depending on the new cost levels.

5. Upon application by an operator and recommendation by the Quota Committee, any B lead quota may be specified to provide premium payments for each pound of lead of over-quota production within a range between 14¾c. and the sum of the ceiling price of lead and A premiums. Any B quota as to which the premium is not specified in cents and tenths of a cent will remain payable at 12c. minus the sum of the ceiling price and A premiums. This provides that at the present ceiling of 6½c. and the present A premiums at 2¾c., B premiums may range from 0.1c. to 5.5c. Any B quotas now assigned, however, will remain at 2¾c. until otherwise specified.

6. The rule which has provided heretofore that major copper mines (defined as mines which produced more than 2,000 tons of copper in 1942) may not receive premiums in excess of the difference between 17c. and the ceiling price is hereby amended. Such mines may now receive premiums not to exceed the difference between 22c. and the ceiling price.

Non-Ferrous Metal Strikes Threaten National Supply

Edgar L. Warren, chief of the Federal Conciliation Service, recently announced that Secretary of Labor Schwellenbach appointed a fact-finding board on March 20 to investigate and seek settlement of nation-wide strikes in the non-ferrous metal industry involving approximately 80,000 workers. The board, which was directed to convene in Denver, Colo., on March 25 and report findings within 30 days, consists of: George E. Strong, Washington, D. C., attorney, chairman; Judge James Wolff, of the Utah Supreme Court; and Dr. Carl Borgman, head of the chemical engineering department, University of Colorado.

Mr. Warren also announced that the Labor Department would ask the International Union of Mine Mill & Smelter Works, CIO, to call off strikes now in effect and others to be called shortly. It is hoped that these attempts will avert serious shortages of lead and certain forms of copper which are threatened because of strikes which began in some plants on Feb. 25 and later spread to affect mining, smelting and refining operations of the American Smelting & Refining Co., the Phelps Dodge Corporation, the United States Smelting, Refining & Mining Co., and the Kennecott Copper Corporation. The following reports trace developments on the strike situation in various parts of the nation:

A.S.&R.Co.

The American Smelting & Refining Co., which operates 18 plants situated in 12 different states, reports that the union refused to bargain on contracts which had expired, and demanded a general wage increase of 30c per hour, and elimination of all geographical differentials based on a minimum scale of $7.50 per 8-hr. shift for common labor and $9 per shift for journeymen. On Jan. 21 two of the plants went on a strike, and on Feb. 25 the remaining 16 plants struck.

Phelps Dodge Co.

Mining and smelting operations of the Phelps Dodge Copper Co., at Bisbee, Morenci, and Douglas, Ariz., stopped on March 20 because of unsuccessful negotiations with the OPA and the I. U. of M. M. & S. W. Company operations at Tyrone, N. M., were also closed. Approximately 5,300 workers were estimated to be idle. Company and union representatives stated that they had agreed upon a wage increase of approximately 18 percent, but that the OPA had declined to give the company an adequate copper price. The company rejected the offer of a subsidy as unsatisfactory both in operation and duration.

Anaconda Copper Co.

Union representatives notified the Anaconda Copper Mining Co. of intentions to strike at company operations in Butte, Anaconda and Great Falls, Mont., on March 31 following a statement of the company that it was unable to grant any wage increases.

The strike was postponed on April 1 to permit further discussion of a contract involving wage increases.

Coeur d'Alene District

In a drive for a 30 percent wage increase in the Coeur d'Alene mining district, locals 14 and 18 of the International Union of Mine, Mill & Smelter Workers started negotiations early in March with officials of the following operations: Dayrock, Sherman, Tamarack, Hercules mill, Sunset lease, Golconda mill, Bitco, Coeur d'Alene mine, Sunshine mine, Hull lease, Formosa mill, Small lease mill, Douglas mine, Spokane - Idaho, Highland Surprise, Denver Development, Sydney mine, Sunset Minerals, Bunker Hill mine, Bunker Hill smelter, Bunker Hill zinc plant, John George lease, Morning mine, Hunter lease, and Frisco.

Despite participation of Donald G.

Goodman, Federal labor conciliator, and a readiness of the operators to continue negotiations, George Knott, representative of the international union, declared that further attempts at collective bargaining were futile, and announced on March 13 that votes on a general strike in the district would be held within the following 30 days for every property in the district except those of the Federal Mining & Smelting Co. Mr. Knott indicated that this company was excluded because nation-wide strikes against the American Smelting & Refining Co., which manages the Federal company, were sufficiently effective for union strategy.

To prepare "for any eventualities which might appear" in the struggle for higher wages, members of locals 14 and 18 voted to assess themselves one dollar a week. In further preparation white-helmeted members carrying posters mounted on short broomsticks collected at the gates of the Bunker Hill & Sullivan zinc plant urging non-union employees to sign up with the CIO. This conduct was cited by an attorney representing mining companies in the district as violation of a contract which was signed on Sept. 25, 1945, by union officials and 22 mining companies, wherein both parties agreed to refrain from coercion. This contract, which terminates June 30, 1947, also establishes standard wage rates for the Coeur d'Alene district, and contains a clause wherein the union agrees "for the duration of the contract there will be no strikes, stoppages of work or unavoidable interruptions of production." The companies agreed not to use lockouts for the same period. New wage negotiations were permitted, however, upon proper notice.

Previous to the decision of the union to hold elections for a general strike in the district, Local No. 18, balloted separately on March 17 in favor of striking against Bunker Hill. Four union personnel armed with rifles guarded the union hall while the balloting was held. These were later dismissed upon request of the county sheriff and Kellogg police chief, who agreed to maintain law and order. Although the National Labor Relations Board under the Smith-Connally Act is required to supervise strike votes, with every employee in the unit being permitted to vote, the union maintained that failure of Congress to provide NLRB with funds to hold votes justified the union to hold its own vote. The Bunker Hill company had previously offered to provide funds for a NLRB-conducted poll.

Particular significance is attached to the pressure for still higher wages in the Coeur d'Alene district because unions in other Western states, including Utah and Nevada, have contended that existing wages in the Coeur d'Alenes justified equal wages elsewhere. These contentions were overruled by the National War Labor Board, which denied 5,000 employees of 15 Utah and Nevada metal mining and smelting companies general wage increases on those grounds in December, 1944.

This issue was not allowed to die, however, for District Union No. 2 of I. M. M. & S. W. insisted that wage rates in Utah and Nevada must be raised to those of the Coeur d'Alenes when it applied to NLRB on Oct. 4, 1945, for permission to ballot.

Magma Reports Tonnage In New Property

The Magma Copper Co. reports that an area of 1,000 ft. by 4,000 ft. has proved to be mineralized at the San Manuel property, in Arizona, as the result of more than 39,000 ft. of churn drilling. Two ends and one side of the orebody remain open for extension.

An estimate of tonnage confined within the boundaries of completed drill holes indicate 83,900,000 tons of ore averaging 0.79 percent copper and containing small and as yet undetermined amounts of gold, silver and molybdenum. The total is made up of 35,300,000 tons of oxidized ore assaying 0.74 percent copper largely in the form of copper silicate; 20,800,000 tons of secondary ore assaying 0.86 percent copper composed of mixed copper silicates and sulphides, and 27,800,000 tons of sulphide ore assaying 0.81 percent copper.

Approximately 36,700,000 tons of ore will be amenable to ordinary sulphide flotation, and the remainder of 47,200,000 tons will have to be treated by methods yet to be determined.

Edwards Division Trains Veterans for Mining

An opportunity to alleviate manpower shortages in mining lies in the possibility of organizing a government-approved veterans' training program. The Government will assist in developing the training course and it will share the wage cost of the trainees under the terms of the G. I. Bill. The Edwards Division of St. Joseph Lead Co. has had such a program in operation since January, 1946, and in the following paragraphs, R. J. Mechin, manager, reports on the success of the venture:

"In the late fall of 1945, when job training in mining became available to World War II veterans, we made application to the New York State Apprentice Council for approval of our proposed training schedule. This approval was required before the Veterans Administration would accept our veterans for the benefits offered under the plan.

"Our program is designed particularly for training machine men, of whom we were woefully short. It is given herewith essentially as submitted to the New York State Apprentice Council:

TRAINING PROGRAM

"(a) Working on grizzly, where the trainee would become familiar with the use of explosives, the simplest operation of a hand-held pneumatic drill, and the general 'feel' of underground work. He would work with an experienced man. *Two months.* (b) Working on grizzly, but working by himself. *One month.* (c) Tramming. Consists of loading ore into 3-ton cars and hauling them by means of electric locomotive to storage chamber, where they are automatically dumped. *One month.* (d) Scraping. Moving the broken ore to the grizzly by means of scrapers and double-drum electrically operated hoists, varying in horsepower from 15 to 25. *Two months.* (e) Working on a pneumatic drill with an experienced man in order to learn to operate the drill to best advantage in the various types of rock encountered in the mine, and in the various classes of working places. *Four months.* (f) The trainee then does the foregoing work by himself to demonstrate that he is a qualified miner. *Two months.*

"In due time, this program was certified to the Veterans Administration at Batavia, N. Y., and all subsequent dealings have been with that organization. The plan was put into effect on Jan. 1, 1946, and results have been excellent. We have enrolled 30 young men in the program and to date (early March) have only had two whose work was not satisfactory and who had to be dropped.

"Briefly, the whole program is based upon the proposition that while the trainee is undergoing his period of training, the Government will pay him the difference (exclusive of any overtime pay considerations) between what he actually earns and what he would earn were he fully qualified under the final objective classification for which he is training; i. e., in our particular case, a machine man, driller, miner, or whatever happens to be the local term for that class of mining work.

"The amount of preliminary lecturing and discussion can be varied to suit local conditions, such as the amount and kind of supervision available, the character of the trainees, or the Safety First program in operation at the property. We have found the *Engineering and Mining Journal's* booklet, 'Take a Look at Mining—Ex-Serviceman' quite helpful.

"There is a surprisingly small amount of Government red tape and extra bookkeeping involved in the whole plan, and even though there are inevitable delays due to the Veterans' Administration being simply swamped with such work, the men involved are already familiar with Service red tape and delays and seem to realize that eventually they will receive from the Government all the money due them.

"Our experience has been that reasonably complete information is readily available at local draft boards, United States Employment Service offices, and, of course, Veterans Administration offices.

"We trust that these few notes will encourage other mine and mill operators who are harassed by continuing labor shortages to undertake an on-the-job training in mining (or milling) program, as it has been most helpful to us and can be applied ultimately to any class of work in our industry."

OPERATING IDEAS

Pneumatic Guides Provide Smoother Skip Travel

W. SMITH
Mechanical and Electrical Superintendent, Wright-Hargreaves Mines, Ltd., Kirkland Lake, Ontario

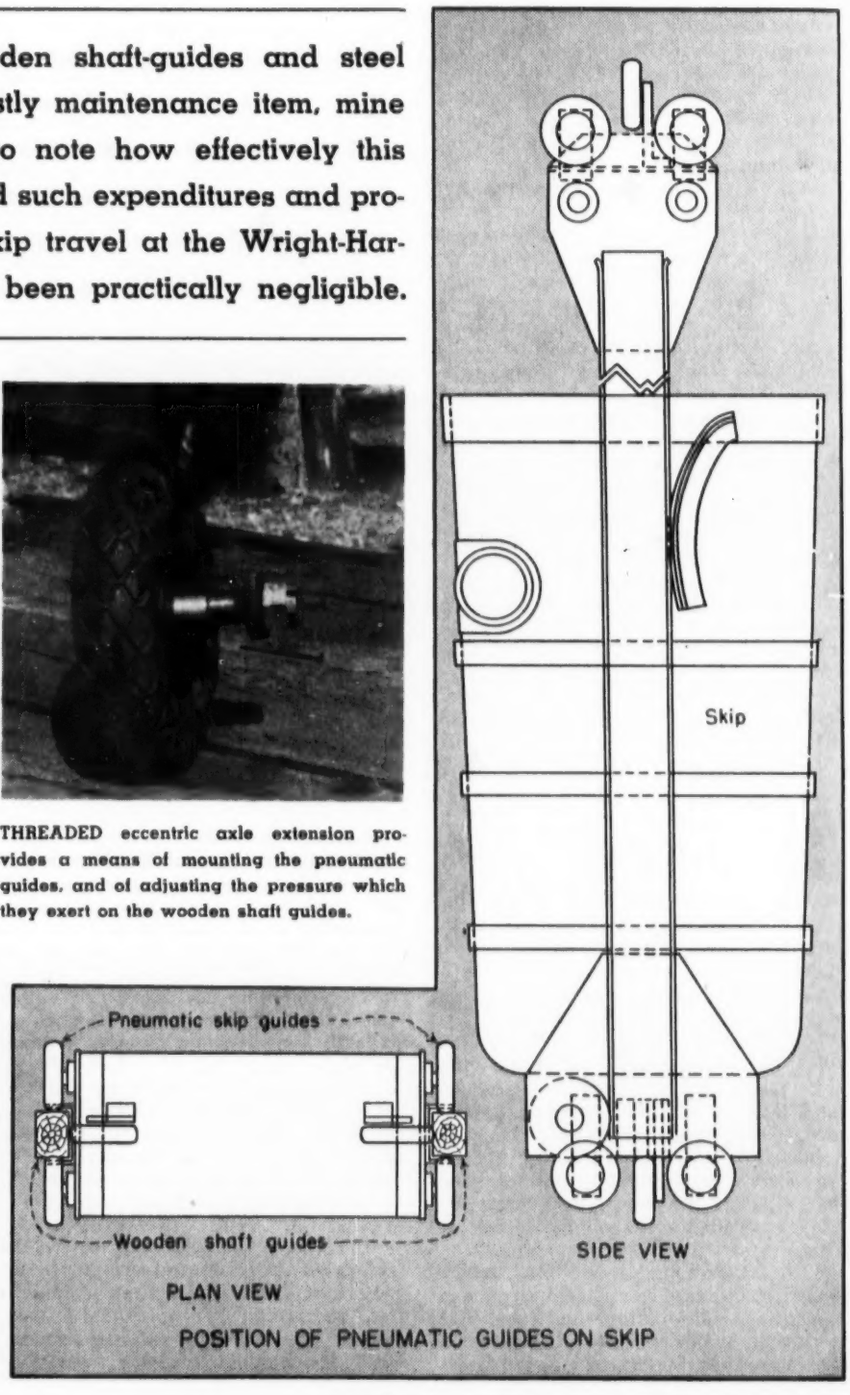
Because replacement of wooden shaft-guides and steel guide-shoes is generally a costly maintenance item, mine operators will be interested to note how effectively this unique installation has reduced such expenditures and provided smooth, abrasion-free skip travel at the Wright-Hargreaves mine. Tire wear has been practically negligible.

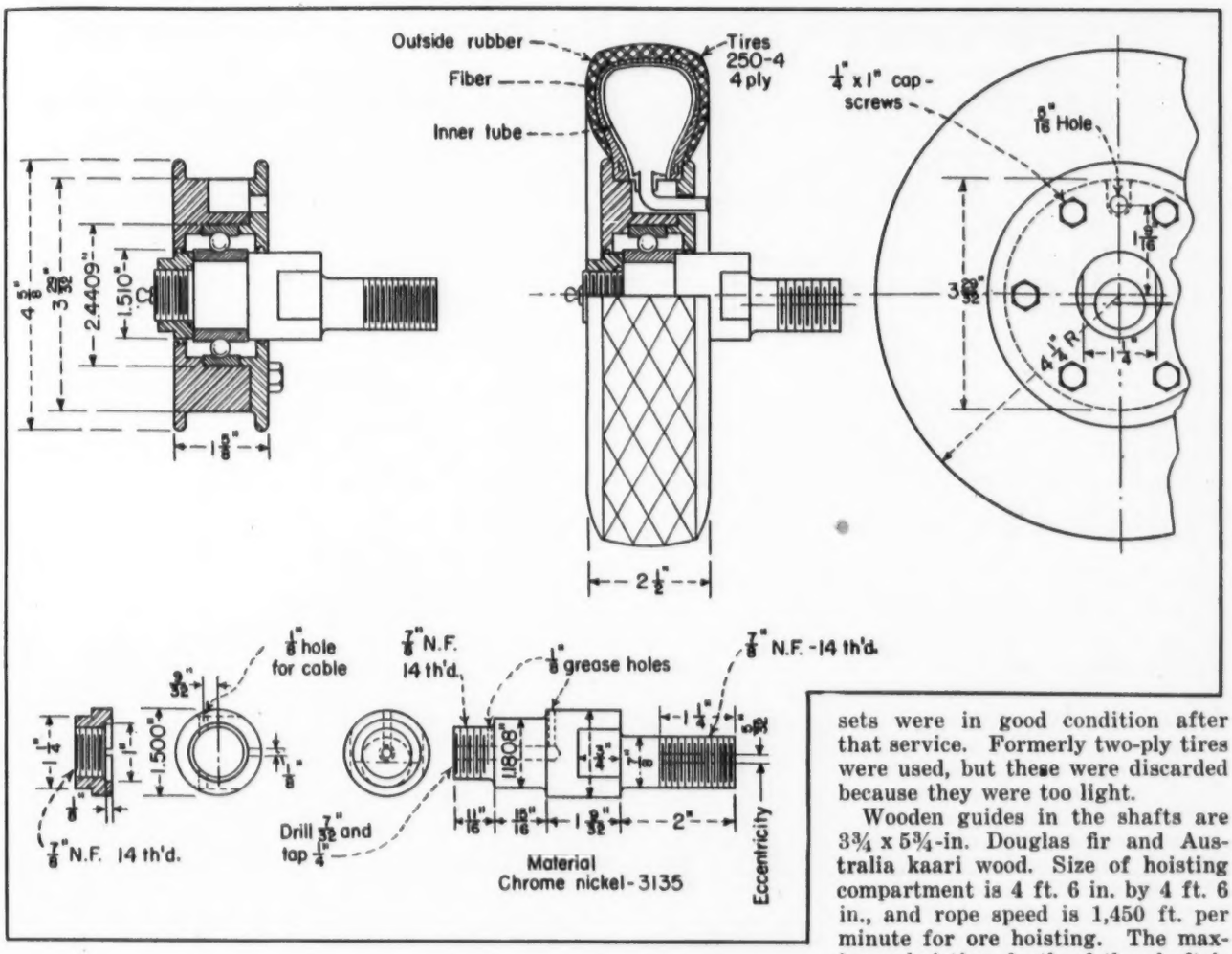
The Wright-Hargreaves pneumatic skip guide, which was developed at the company property, Kirkland Lake, Ontario, and installed on 4-ton skip assemblies, has virtually eliminated wear on wooden shaft guides. Observations dating back to 1941, when pneumatic guides were first installed, have demonstrated the following advantages for the equipment:

1. Travel of skips in the shaft is smooth and practically noise-free.
2. Wooden shaft guides are kept in clean condition.
3. Very little tire wear has been noted.
4. Time required for shaft-guide and skip repairs has been reduced to a minimum.
5. An eccentric axle incorporated in the design enables operators to adjust the fit of the pneumatic guides against the wooden shaft guides speedily and easily.

Construction details and assembly of the pneumatic guides are shown in the accompanying illustrations. Twelve rubber-tired wheels are mounted on each skip assembly. Each wheel consists of a chrome-nickel machine axle and a ball-bearing rim on which is mounted a Goodyear, Size 250-4, 4-ply, rubber tire. The axis of the 7/8 x 2-in. thread extension of the axle is machined eccentrically to permit easy adjustment. Rotation of the axle with a wrench during adjustment permits a

THREADED eccentric axle extension provides a means of mounting the pneumatic guides, and of adjusting the pressure which they exert on the wooden shaft guides.





5/16-in. movement of the position of each wheel, which is adequate to compensate for wear or any other condition requiring modification.

Tires are inflated to 40 lb. Pressure-reducing units for this purpose are installed in compressed-air outlets in the headhouses of the shafts. Performance records revealed that one set of four-ply tires operated 3,248 hr. in one shaft, and another set, 2,640 hr. in a second shaft. Both sets were in good condition after that service. Formerly two-ply tires were used, but these were discarded because they were too light.

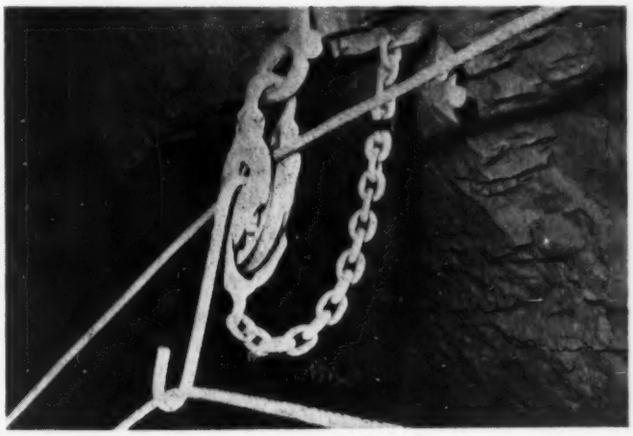
Wooden guides in the shafts are 3¾ x 5¾-in. Douglas fir and Australia kaari wood. Size of hoisting compartment is 4 ft. 6 in. by 4 ft. 6 in., and rope speed is 1,450 ft. per minute for ore hoisting. The maximum hoisting depth of the shaft is 4,000 ft., with 9 loading pockets and 30 levels.

The helpful comments of R. L. Healy, mine manager, who granted permission to publish this article, are hereby gratefully acknowledged.

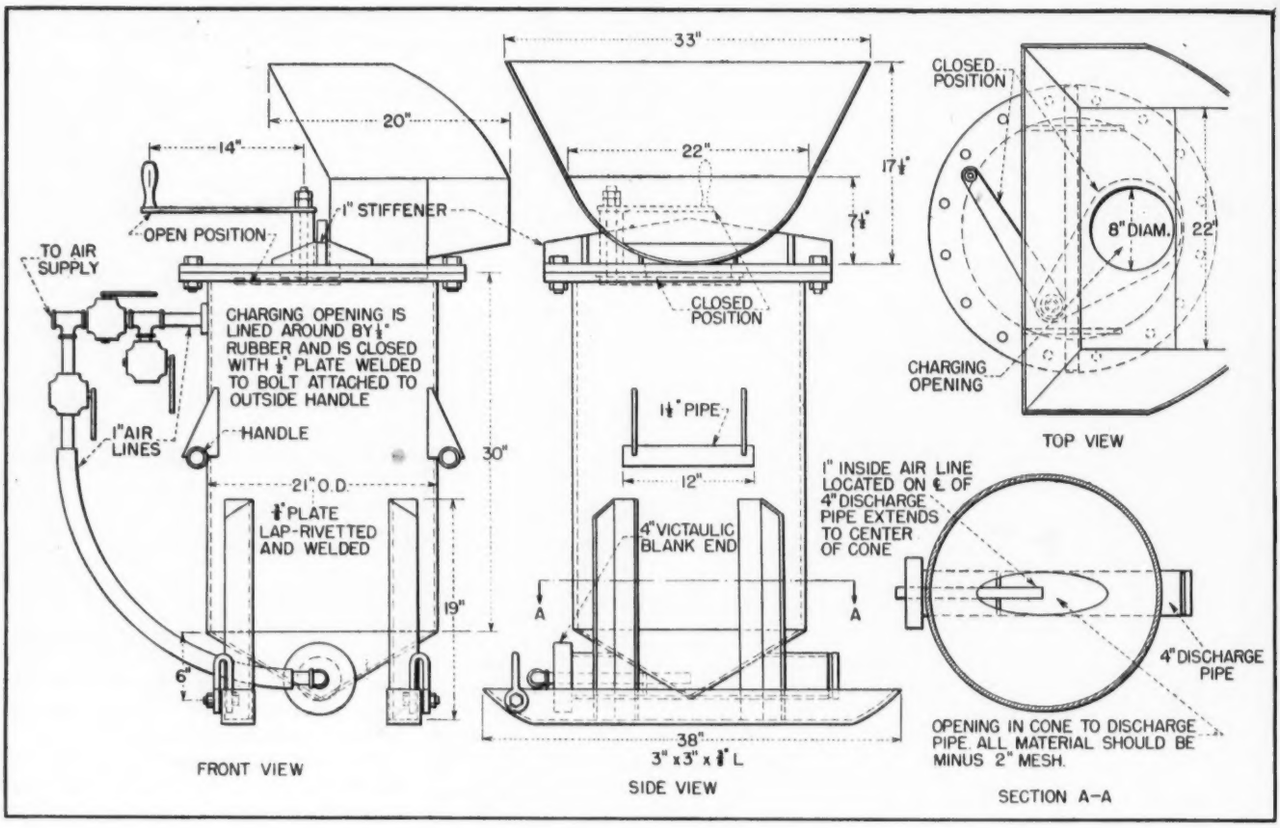
Hanger Protects Slusher Rope From Blast

In scram-drift mining, especially where rock is broken by long holes drilled from a sublevel, the rock delivered to the fingers is often extremely large. Secondary blasting is therefore necessary in scram drifts to reduce the large rocks to a size which can be handled by scrapers. Scram-drift crews are fully aware of the difficulties which ensue if the pull-rope or tail-rope on the slusher is not securely suspended out of the way when such secondary blasting takes place.

The accompanying photograph shows a pipe hanger which is slipped into the sheave block to serve as a cable support. Roger Pierce, of the Ingersoll-Rand Co., who submits the idea, also calls attention to the chain which serves as a secondary anchor for the sheave block in case the main anchor pin fails.



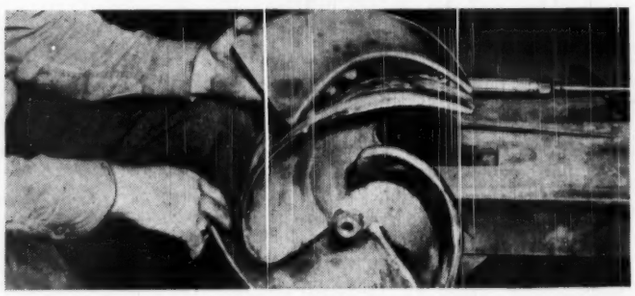
Portable Concrete Gun for Underground Construction

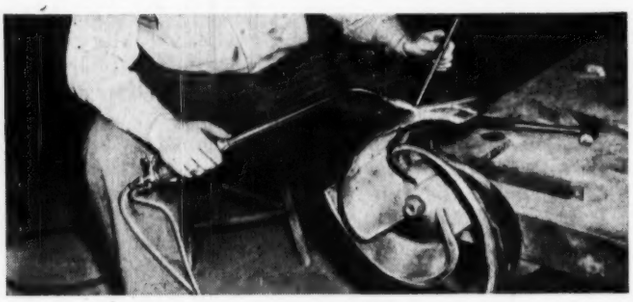


The illustrated sketch of a concrete gun was submitted by K. Dewar, mine superintendent of the Kerr-Addison Gold Mines, Ltd., Virginiatown, Ontario, who states that it was employed successfully to pump concrete into forms which were set for underground shaft station installations. The contents of a 5 cu. ft. mixer are discharged into the opening at the top of the cylinder. Then the rubber-gasketed cover is rotated into closed position. Air pressure is applied at the top of the aggregate and simultaneously into the discharge pipe. Thus the applied pressure seals the top of the cylinder and boosts the concrete into position, at the same time aërating it to lighten the lifting load.

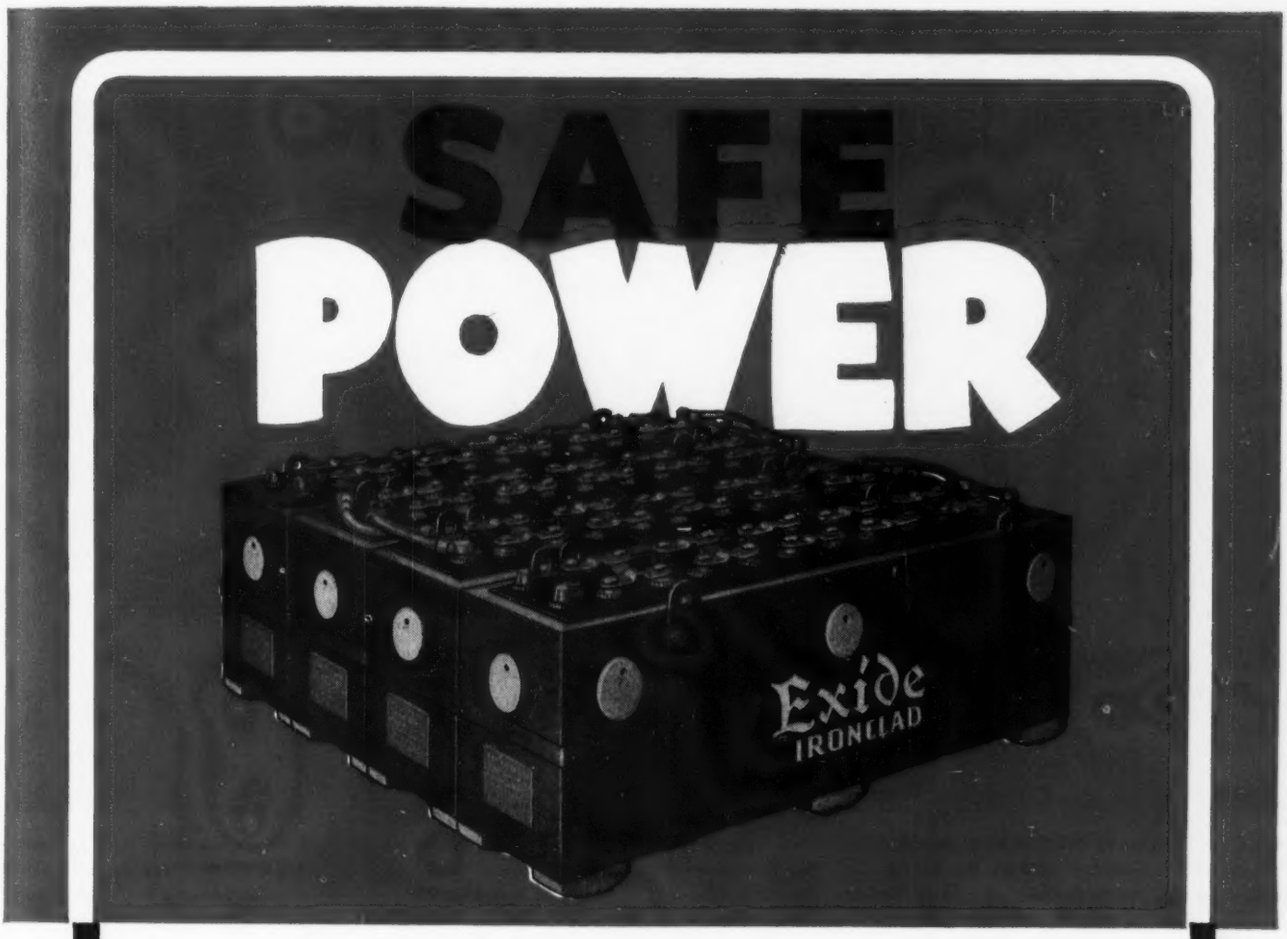
The speed of discharge is sufficiently rapid to force the air out of the concrete when it hits the rock walls and wooden forms, and forces the aggregate into irregular recesses commonly encountered. In some instances concrete has been pumped as high as 25 ft. and as much as 50 ft. horizontally. The unit is moved about on skids welded to the legs.

Bronze Surfacing Restores Worn Pump Impellers





Here is a way to restore worn cast-iron pump impellers to usefulness: (1) Remove all grease, dirt, and rust with a wire brush. (2) Clean the surface chemically with a liberal application of flux. (3) Apply bronze weld metal. On the repair job shown herewith, Oxweld 31 T bronze rod was applied with a slight oxidizing flame. (4) While building up the surface, check deposition frequently with a sheet-metal template constructed to conform to the desired shape of impeller as shown at right. This saves rods and gas, and reduces labor for grinding and finishing. Photographs courtesy of Oxy-Acetylene Tips.



EXIDE POWER SPEEDS UP HAULAGE, CUTS COSTS

Exide-Ironclads are engineered and powered to safely meet the heavier haulage requirements of today's mine, quarry and tunnel operations. They have the ruggedness necessary to withstand the greater strain that increased tonnage demands. And they provide the safety that reduces mine hazards.

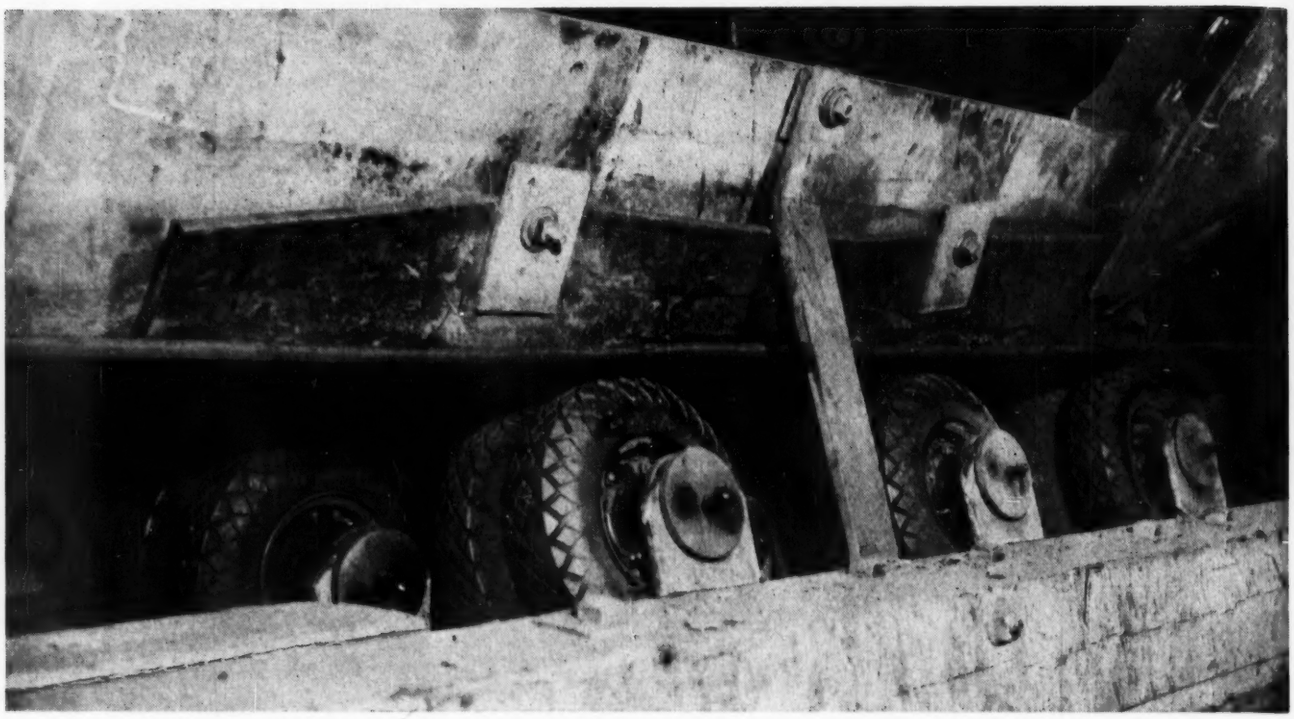
With Exide-Ironclads on your trammers, locomotives and shuttlecars, you can count on the *high power ability* that frequent "stop and go" service requires...a *high maintained voltage* throughout discharge... the *high capacity* that provides full shift availability and sustained speeds throughout the day. Exide-Ironclad construction is assurance of these dependable qualities PLUS safety, long-life and ease of maintenance.

Exide
IRONCLAD
BATTERIES

If you have a special battery problem, or wish more detailed information, write for booklet Form 1982.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

Rubber Tires Absorb Shock of Falling Rock



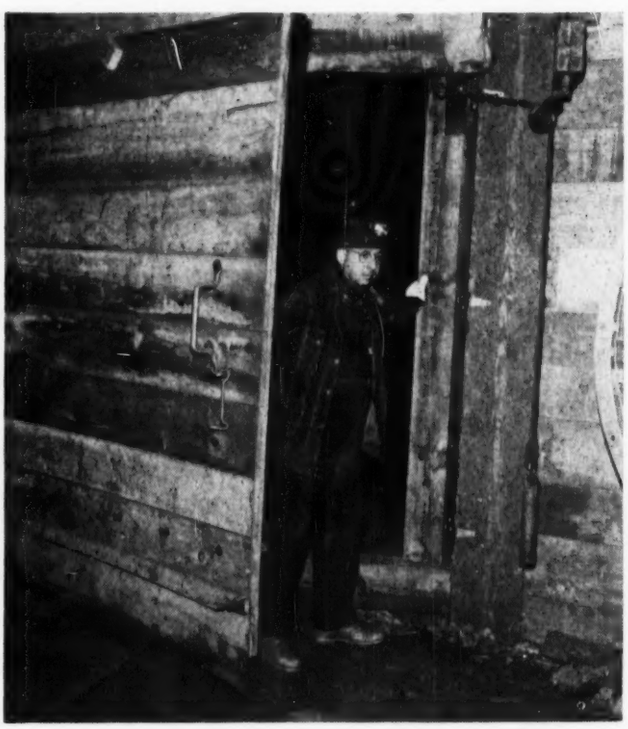
SHOCK OF FALLING MATERIAL is absorbed by 4.00x8, 6-ply, bearing-mounted pneumatic tires at the Locust Coal Co., Shenandoah Valley, where the illustrated 36-in. belt handles over 450 tons of coal, rock, and shale per hour. Little or no wear was noticeable after a year of operation. The belt installation was built by Goodyear Tire & Rubber Co. Tires are mounted beneath the loading point.

Hinged Door Jamb Prevents Accidents

This ventilation door with hinged jamb was installed in one of the tunnels of the Sunrise mine of the Colorado Fuel & Iron Co., Sunrise, Wyo., to avoid injury to workers on the haulage crew and minimize damage to equipment. George Du Fond, safety engineer, who designed the door, is shown here demonstrating how the jamb is able to swing in event of an emergency.

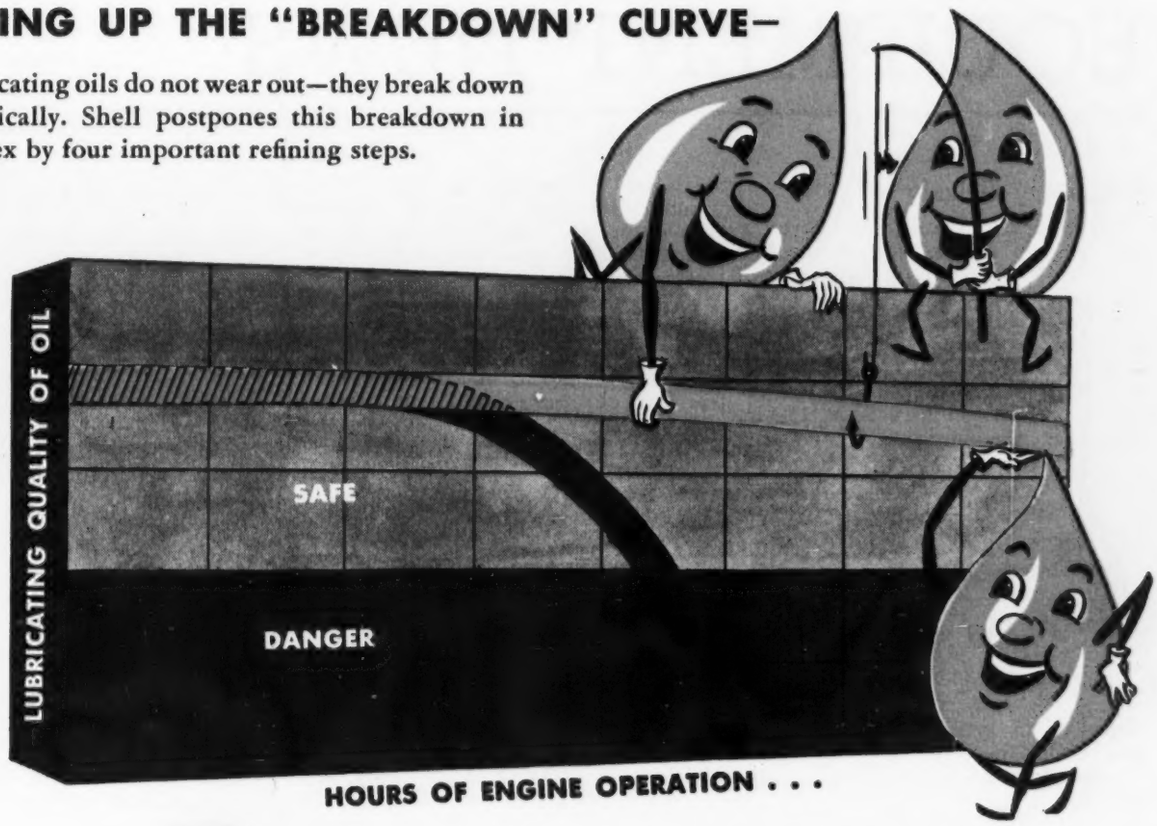
The jamb has a counter balance which holds it in normal position. If the door is struck by a train traveling in the opposite direction in which the door normally swings to open, the jamb will not resist the pressure applied on the door, but will swing back and allow the train to pass through without damaging the haulage equipment or injuring the crew.

Mechanical details of a similar design which was employed in an Arizona copper mine were shown in *E.&M.J.* for December, 1943. The idea is again presented because of the advantages which are illustrated so clearly here, and to encourage wider adoption of an installation which may prevent damage to equipment and injury to employees. Photograph by Thos. J. Barbre, Denver, Colo.



HOLDING UP THE "BREAKDOWN" CURVE—

Lubricating oils do not wear out—they break down chemically. Shell postpones this breakdown in Talpex by four important refining steps.



THESE 4 TALPEX PERFORMANCE FACTORS SAFEGUARD HIGH-SPEED DIESELS

1.

Talpex is protected by the removal of the oil's natural liabilities—those oil components that readily oxidize. Shell does this by means of a special solvent-extraction process.

2.

Talpex is protected with an anti-oxidant that effectively serves to still further retard the formation of corrosive compounds and objectionable sludge and lacquer.

3.

Talpex has effective corrosion-preventive properties which are obtained by special refining methods. This means better performance and longer life of the engine's wearing parts.

4.

Talpex has detergent properties that keep carbon, lacquer and rust particles from adhering to pistons, rings, valves and ports—keeps these contaminants "moving" until drained from the engine.

The Shell Lubrication Engineer will give you sound advice about the lubrication of *any* type of Diesel, whether slow, medium, or high-speed. Write for a copy of Shell's booklet, "The Fundamentals of Diesel Lubrication." Shell Oil Company, Incorporated, 50 West 50th Street, New York 20, New York or 100 Bush Street, San Francisco 6, California.

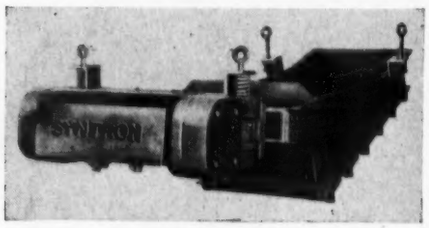
SHELL

SHELL DIESEL LUBRICANTS

EQUIPMENT NEWS

Vibratory Grizzly

Large-capacity, heavy-duty vibrating grizzlies are now a part of the line of Vibra-Flow feeders, manufactured by Syntron Co., 510 Lexington, Homer City, Pa. The unit illustrated has a conveying capacity of 200 tons per hour, but capacity will be somewhat less if great screening action is required. Separation here is at 1½ in. Action of the pulsating magnet at-



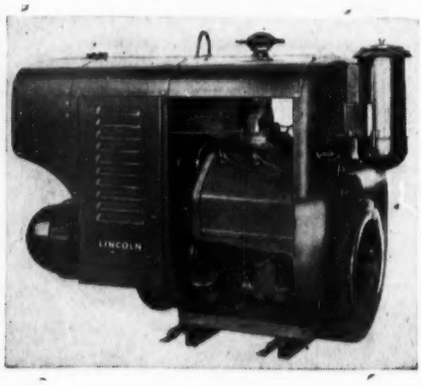
tached to the grizzly is to vibrate the bars 3,600 times per minute, which tumbles the material and hastens separation.

Rheostat control of feed is possible with these units, which in turn makes possible automatic control of the feeder in conjunction with the crusher that it feeds. Low maintenance and operating costs are said to be part of this machine because the vibrating movement is confined to the spring bars that actuate the reciprocating trough. No other moving parts are required. The company states that units with capacities up to 500 tons per hour are available.

Low-Priced, Compact Welder

A new portable welder of the gasoline engine-driven type is announced by Lincoln Electric Co., Cleveland, Ohio. Price of the unit is said to be that normally paid for the welding generator alone.

Known as "Shield-Arc, Jr.," the new machine has a current range of 40 to 250 amp. It measures 24x48x30 in. and weighs, net, 660 lb. The welder is powered by a Wisconsin air-cooled, four-



cylinder V-type engine. Speed of the engine determines the welding current. The unit will operate under normal conditions for about six hours without refueling.

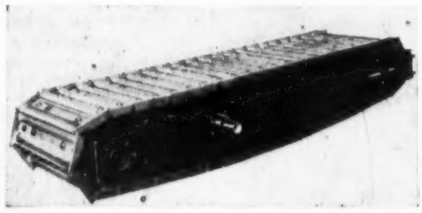
Change-House Spray

A most annoying and frequent result of use of shower baths in change houses, or similar facilities, is the acquisition of a case of athlete's foot. The customary small tank full of disinfectant into which one is forced to step on leaving the shower room is neither pleasant nor effective. An arrangement that gives promise of being inoffensive to use, and of killing the bug, is the "Peda-Spray" recently announced by Peda-Spray Co., Inc., 55 West 42nd St., New York, 18, N. Y.

The device is simply a pressure spray enclosed in a low, round base 26 in. in diameter. The user steps on the grating top of the base and tramps with a side-to-side pressure. His feet are then sprayed with a solution that eliminates the athlete's foot organism. Fresh spray is used for each man. The unit was supplied during the war to Army and Navy installations, but it is now available for civilian use.

Apron Conveyors

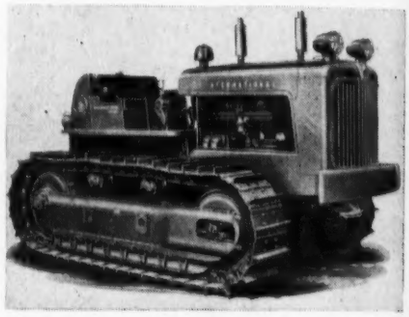
Completely self-contained, factory-assembled, heavy-duty apron conveyors are now available from Chain Belt Co., Milwaukee, Wis. The units are furnished in several widths and with centers ranging from a minimum of 4 ft. 7 in. apart to a maximum of 9 ft. 1 in.,



in 18-in. increments. Capacities of these standard units run up to 80 tons per hour. Power consumption is said to be low, and belt life, long, because the chain belt rides directly on traction rollers.

Heavy-Duty Tractor

The largest tractor ever built by International Harvester Co., Chicago, Ill., was recently announced by that company as an addition to its line. The new tractor, the TD-24, weighs 35,000 lb. and has 130 hp. maximum drawbar pull. Powered by a new International



six-cylinder full diesel engine, the tractor has eight speeds from 1.6 to 7.8 mph. The new unit is not for sale at present, but, along with new International diesel engines and wheeled tractors, it will be available when production begins at the company's new Melrose Park plant.

Drill-Bit Extractor

A magnetic device for recovering broken drill bits, diamond bits, or broken drill rods from rock-drill holes has been announced by Dings Magnetic Separator Co., Milwaukee, Wis. Made of a new type of Alnico steel, the bit extractor can lift about 25 times its own weight in vertical lifts, and is said to possess unusual holding ability on small or uneven surfaces.

Use of the extractor may avoid the necessity of redrilling holes in which detachable bits have broken off. The device is simply fastened to the face of an old bit and put into the hole on the end of a drill rod. The extractor weighs one pound and is made in 1¼- and 1½-in. diameters.

Tamping Bags

Made of an extra-quality paper designed to stand up under high humidity, new Seal-Tite tamping bags are now offered by the Tamping Bag Co., Mt. Vernon, Ill. Samples of the bags for testing purposes will be furnished by the company.

Hard-Facing Electrodes

One new and one improved electrode, each of the type used for specific hard-facing applications, have been announced by Lincoln Electric Co., Cleveland, Ohio. Abrasoweld AC is designed for building up straight carbon steel, low-alloy steel, or high-manganese steel, with a self-hardening deposit to resist abrasion and impact. The improved electrode, Manganweld A, is again available and is manufactured specifically for reclaiming worn aus-

MODERN, LOW COST MINE HAULAGE —Now a Must!

There's no time to lose in getting mine haulage costs on a competitive cost-per-ton basis. Modern battery-powered locomotives, trammers and shuttle cars are a *must*. And for power to keep such equipment working at capacity, *at lowest cost,* specify the newest in motive power Storage Batteries, the sensational Philco "Thirty" that gives 30% longer life.

Philco "Thirty" Shuttle Car Storage Battery is identified by its distinctive red connectors

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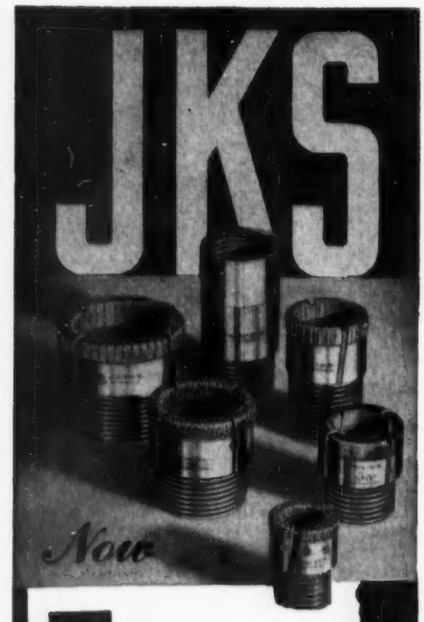


3 Types of
CORE BITS

Each of the three types of JKS core bits is designed to operate at high efficiency and low cost.

Use HI-CASTE core bits for drilling in hard, fine-grained, solid formations.

Use HARDHED core bits for drilling in broken, irregular or coarse abrasive formations.

Use FERRET bits for drilling in extremely hard formations where whole stone bits polish rapidly or for drilling in weathered, broken or very abrasive ground. The Ferret bit, a self-sharpening impregnated bit, requires no resetting.

Consult JKS engineers on selection of core bits and other diamond drilling problems.

J. K. SMIT & SONS, Inc.

157 Chambers St., New York 7, N.Y.

tenitic manganese steel parts containing 11 to 14 percent manganese. The former electrode is best suited for a.c. work, and the latter for d.c., but both can be used with either current as desired.

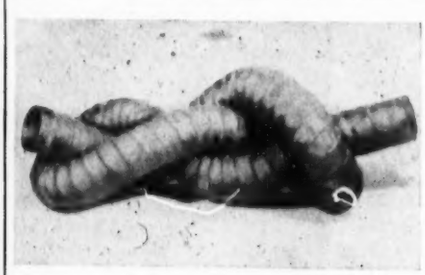
Wire Rope Clamp

A new type of wire rope clamp is now offered by Nunn Manufacturing Co., 2125 Dewey Ave., Evanston, Ill. Called the Cabl-ox, the clamp will hold loads in excess of the tensile strength of the

rope, and can be easily assembled by unskilled labor. Shown in the accompanying diagram, the clamp is made of alloy steel, cadmium plated, and comes in all standard sizes from 1/16 in. to ¾ in.

Flexible Tubing

A new type of flexible tubing, non-collapsible and retractable to about one-eighth its extended length, is now supplied by Warner Brothers Co., Spiratube Division, Bridgeport, Conn. A feature of the tubing is that the spring core holding the tube open is



stitched into the long-fiber duck fabric in such a way as to eliminate inner resistance to air flow. The fabric is coated with a thermoplastic and is fire-resistant. It is supplied in diameters of from 3-in. to 16-in. and in lengths of 10, 15, and 25 ft.

Outward-Feed Flotation

A new patented principle of agitation and aëration is said to be employed in the new Massco-Fahrenwald flotation machine now offered by Mine & Smelter Supply Co., Denver, Colo. Developed by Dr. A. W. Fahrenwald, dean of the School of Mines, University of Idaho, the new machine makes use of an "outward-feed" principle that is said to result in greatly increased aëration, more air per unit of power, better distribution of air, and ability to increase aëration with feed overloads.

A distributor body over the impeller of the Massco-Fahrenwald machine provides separate feeding compartments for pulp and air. Pulp passes downward from the distributor body onto the radial vanes of the impeller, which throw the pulp out into the cell space. Air is thereby drawn down a well around the impeller shaft, but it joins the pulp only where the pulp hits the impeller vanes. The impeller and distributor form an aëration unit that may be installed to provide individual cell operation, with all pulp passing through each unit, or that may be placed in series in long tanks of the "hog-trough" type.

INDUSTRIAL NOTES

Charles K. King was recently elected chairman of the board of **Ohio Brass Co., Mansfield, Ohio. George L. Draffan** was elected president.

Allis-Chalmers Mfg. Co., Milwaukee, Wis., announces the following staff changes: **A. J. Jorgensen** has been promoted to chief mechanical engineer of the crushing, cement, and mining section; **R. R. Rockafield** has been named engineer in charge, and **Claiborne C. Van Zandt** has been promoted to assistant manager of the division.

Henry W. Erickson, mining engineer, has been transferred from Washington to the firm's New York office. **Melvin C. Shaw** has been named manager of the company's blower and compressor department.

Having purchased all the stock formerly held by **W. B. Straub** and family in the **Straub Manufacturing Co., Inc.**, Oakland, Calif., the following individuals are now sole owners of the company and remain in active control: **J. H. Kueneman**, president and general manager; **C. P. Kenville**, vice president; **Don Kueneman**, vice president; **Alma Harrell**, secretary. The firm's name and management will continue unchanged; but increased manufacturing facilities are planned and several new products will soon be announced.

Alvin F. Franz has been appointed works manager of the Pueblo, Colo., plant of **Colorado Fuel & Iron Co.**

Traylor Engineering & Manufacturing Co., Allentown, Pa., has announced the appointment of **Clyde W. Spears** as special sales engineer. Mr. Spears served during the war as a lieutenant colonel with an engineering aviation battalion.

Filter Media Corporation announces a shift of its factory and main office from Irvington-on-Hudson, N. Y., to Hamden, 14, Conn.

Kenneth F. Park has been promoted to the newly-created post of engineering consultant to the three sales divisions of Caterpillar Tractor Co., Peoria, Ill.

Sauerman Bros., Inc., Chicago, Ill., announce new distributor appointments as follows: **Intermountain Equipment Co.**, Boise, Idaho; **Robison Machinery**

Co., Salt Lake City, Utah; **Constructors Equipment Co.**, Denver, Colo.; **Highway Equipment Co.**, Cincinnati, Ohio; **Jeff Hunt Machinery Co.**, Columbia, S. C.

Nordberg Manufacturing Co., Milwaukee, Wis., announces the election of **F. H. Kilberry** to the post of executive vice president and director, which was left vacant by the resignation of **C. E. Stryker.**

J. G. Curry has been appointed assistant sales manager of Structural Products Division of Wickwire Spencer Steel Co.

E. R. Galvin, formerly president of Tyson Bearing Corporation, has been named executive vice president and general sales manager of La Plant-Choate Manufacturing Co., Inc., Cedar Rapids, Iowa.

Ideal Commutator Dresser Co., formerly a partnership, announces a change to a corporation to be known as **Ideal Industries, Inc.**, Sycamore, Ill. No other change has been made in location, personnel, or methods.

C. C. Gerow, first director of sales for **Hercules Powder Co.**, has retired after more than 47 years in the explosives industry.

Manufacturing rights for the **BLM "Auto-Centri" clutch** have been obtained by the **Hardinge Co., Inc.**, York, Pa., from Automatic Clutch Corporation of Canada.

BULLETINS

Steel Castings. The wide variety of services in supplying steel castings offered by Vulcan Iron Works, Wilkes-Barre, Pa., is described in Bulletin, A-423, recently prepared by the company.

Earth Mover. The Dozer-Shovel, a combination device for use with International TracTracTors, is described in a new 24-page bulletin prepared by Bucyrus-Erie Co., South Milwaukee, Wis.

Crushers. Allis-Chalmers Mfg. Co. has prepared new bulletins describing its new all-steel frame "A-1" jaw crusher and the Type R reduction crusher. Capacities and constructional features are given. Address Allis-Chalmers, 636, Milwaukee, 1, Wis.

Mining Equipment. The products and manufacturing facilities of Gardner-Denver Co. are interestingly described in a new bulletin prepared by that company.

Wood Tanks. Unusually complete information on use of wood tanks in the mining industry is presented in a comprehensive bulletin just prepared by Santa Fe Tank & Tower Co., Dept. M-10, 4820 Santa Fe Ave., Los Angeles, 11, Calif.

Steel Products. "Fabricated Steel Products for the Mining Property" is the title of a new bulletin of Armco Drainage & Metal Products, Inc., Middletown, Ohio.

Controlling pH. Bristol Co., Waterbury, 91, Conn., announces preparation of a new bulletin describing its line of pH control instruments.

Fence Erection. A manual for erection of chain link fences has been prepared by Wickwire Spencer Steel Co., 500 Fifth Ave., New York, 18, N. Y.

Leather Belting. A wall chart on care of leather belting may be had on application to E. F. Houghton & Co., 303 West Lehigh Ave., Philadelphia, 33, Pa.

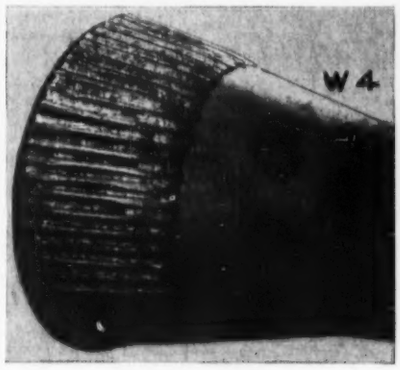
Adjustable Speed Drives. A magnetic adjustable speed drive attachment for fans, pumps, blowers, and compressors is described in a bulletin of Electric Machinery Mfg. Co., Minneapolis, 13, Minn.

Heat Exchanger Calculations. A new slide chart that simplifies the calculation of velocity flow and capacities of heat exchangers is now available on request to Carpenter Steel Co., Welded Alloy Tube Division, Kenilworth, N. J.

Crushing Costs Reduced by Conservation Welding . . . . .

Wear is inseparable from the operation of crushing equipment, and an important factor in operating costs. For many years, the wearing parts subjected to impacts and abrasion have been made of austenitic manganese steel for the longest original life, but even "the toughest steel known," wears down in time in this brutal service.

Costs have been substantially reduced by the reclamation of crusher and pulverizer wearing parts with



Amsco Welding Products, which are so tough and durable that salvaged parts often last longer than the original castings.

W-4 shows a rehabilitated manganese steel 128" crusher mantle. Amsco Nickel-Manganese Steel Filler Bars were swaged by hand to produce the proper contour, and then tacked onto the mantle, using Amsco Nickel-Manganese Steel Electrodes. All the

welds were peened thoroughly. The total cost was $275.00, and the user subsequently reported that the rebuilt mantle lasted as long as a new one.

W-51 is a roll crusher segment used in a coal preparation plant. The rebuilding job is in progress on this segment; one where the worn teeth have been built up repeatedly to their original height with Amsco Nickel-Manganese Steel Welding Rod and then surfaced with Economy Hardface. The Economy welded cap is hammered to a point while the weld metal is still hot.

W-12 compares two manganese steel pulverizer hammers worn down from crushing rock. The hammer on the left has been built up with Amsco Nickel-Manganese Steel Electrodes, after which Economy Hardface was applied to the surface of the weld metal.

In cases where drastic attrition more than heavy shocks is the destructive force, it is economical to hardface new manganese steel castings.

Write for complete details on Amsco Welding Products.

(Amsco Welding Products are produced and sold in Canada by Canadian Ramapo Iron Works, Inc., Niagara Falls, Ontario.)

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Chicago Heights, Ill.; New Castle, Del.; Denver, Colo.; Oakland, Calif.; Los Angeles, Calif.; St. Louis, Mo.

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AMERICAN MANGANESE STEEL DIVISION

CHICAGO HEIGHTS • ILLINOIS

AMERICAN Brake Shoe COMPANY

PERSONAL NEWS

A. L. Burgen has retired as mill superintendent for Calumet & Hecla after 57 years of service with the company. He became mill superintendent in 1896. The Ahmeek mill, as well as the Tamarack reclamation plant and other buildings, were erected during his superintendency.

E. G. Rawlins became assistant manager of the Moctezuma Copper Co. Feb. 1 and has established his headquarters at Nacozari, Sonora, Mexico. Mr. Rawlins was employed by the Moctezuma Copper Co. from 1916 to 1931. The assistant manager's post is a newly created position of the Moctezuma property, which is owned by the Phelps Dodge Corporation.

Ulric S. Annett, western technical representative of Canadian Industries, Ltd., has been elected chairman for 1946 of the Vancouver Branch, C. I. M. **Wing Commander J. C. Dumbrille** is vice chairman and **Dr. Courtney Cleveland** is second vice chairman. **Fred H. Stephens** was reelected secretary-treasurer.

Robert C. Hills has been appointed technical assistant to the president of Freeport Sulphur. He has recently been metallurgical manager of Nicaro Nickel Co., subsidiary of Freeport, and will soon take up his duties in the New York office of the company.

G. F. Laycock, M.C., has been elected president of the Institution of Mining and Metallurgy (British) for the remainder of the 1945-46 session, succeeding the late **Lieut.-Col. Edgar Pam.** He is also president elect for 1946-47.

Clarence A. Fredell has succeeded **J. Murray Riddell** as manager of the mining division of the **E. J. Longyear Co., of Minneapolis, Minn.**

Bennett R. Bates, formerly with the minerals section of BEW, is now with International Mining Corporation of New York.

Dr. Bernard Lewis, an authority on explosives, propellants, and combustion, and whose wartime research activities won him the Legion of Merit, has been promoted to the post of chief of the Explosives Divisions of the Bureau of Mines.

J. N. Ong, concentrator superintendent for Mufulira Copper Mines, Ltd., after 14 years in Northern Rhodesia, has left for the U.S.A. His place has been taken by **Jack White,** and **Ralph B. Adair** has been promoted to assistant concentrator superintendent.

Robert W. Wilson, who until recently has been mine superintendent for the Saudi Arabian Mining Syndicate, Ltd., of Hedjaz, has completed his contract and returned to the States. He is now connected with **Arnold H. Miller,** consulting engineer of New York, and is doing exploration work in Montana and Nevada.

A. T. Beauregard, manager of Monsanto's plant, at Monsanto, Tenn., has been promoted to special assistant to **R. R. Cole,** general manager of Monsanto's Phosphate Division, and will move to St. Louis, Mo., where the company's executive headquarters are located. **John L. Christian** has been promoted from assistant plant manager to plant manager at Monsanto, Tenn. Mr. Beauregard is a civil engineering graduate of Rensselaer Polytechnic Institute at Troy, N. Y. He spent about ten years in heavy construction work in the South and East before joining the chemical industry.

Oscar N. Friendly, Park Utah Consolidated vice president and general manager, and associated with the company for 37 years, retired on April 1, but will continue in a consulting capacity. He is suceeded on the Park Utah official staff by **Paul H. Hunt,** of Keetley, Utah.

E. D. Rhodes is in charge of the mining engineering and assay departments of the Fred Hughes Laboratories, 620 Eye St., Sacramento, Calif.

H. W. Strlay III, after nearly four years as chief of the Forest and Mineral Product Section of Supply and Resources Service, FEA, has retired from the government service. He has opened consulting offices in Washington and will specialize in geological and geophysical explorations. His address is 5532 Friendship, Washington 16, D. C.

Dr. Lester W. Strock, geochemist and spectrographer, announces the organization of Spectrographic Services & Supplies, Inc., with laboratory at 21 Madison Ave., Saratoga Springs, N. Y. Dr. Strock is a graduate of the University of Pennsylvania and spent four years in post-graduate work in European universities. He is a member of the A.I.M.E. and the Society of Economic Geologists.

H. Robert Hughes has been appointed assistant chief engineer in charge of raw materials for Jones & Laughlin Steel Corporation.

Max Paul Jasmer, who recently resigned his position in the mechanical electrical section of the U.S. Army Engineer Corps at Fort Sam Houston, Tex., has gone to Paraguay, South America. He may be reached at Casilla de Correo No. 194, Asuncion, Paraguay, S. A.

Otis Everett, of Baxter Springs, former Tri-State purchasing agent for the Eagle-Picher Mining & Smelting Co., has been retired by the company. **Ollie Wampler** of Webb City, former safety engineer for the company, also has been retired. For the last decade or so Wampler had been employed in the Oronogo office of the company.

Howard H. Utley, of Baxter Springs, former Tri-State manager for district operations of the St. Louis Smelting & Refining Co., has opened an office as consulting mining engineer in the Douthit Building at the northwest corner of Eleventh St. and Military Ave.

Roland D. Parks, deputy director of the Metals and Minerals Division and Chairman of the Quota Committee, Premium Price Plan for Copper, Lead, and Zinc, left the Civilian Production Administration at the end of February to return to the Massachusetts Institute of Technology to teach the Mineral Industry option of the Geology Department curriculum. With the war agencies since 1941, Professor Parks was successively deputy director of the Miscellaneous Minerals Division and assistant deputy vice chairman for Metals and Minerals, WPB, prior to his recent position with CPA, and was associated with committees on coordination of mineral programs and stockpiling.

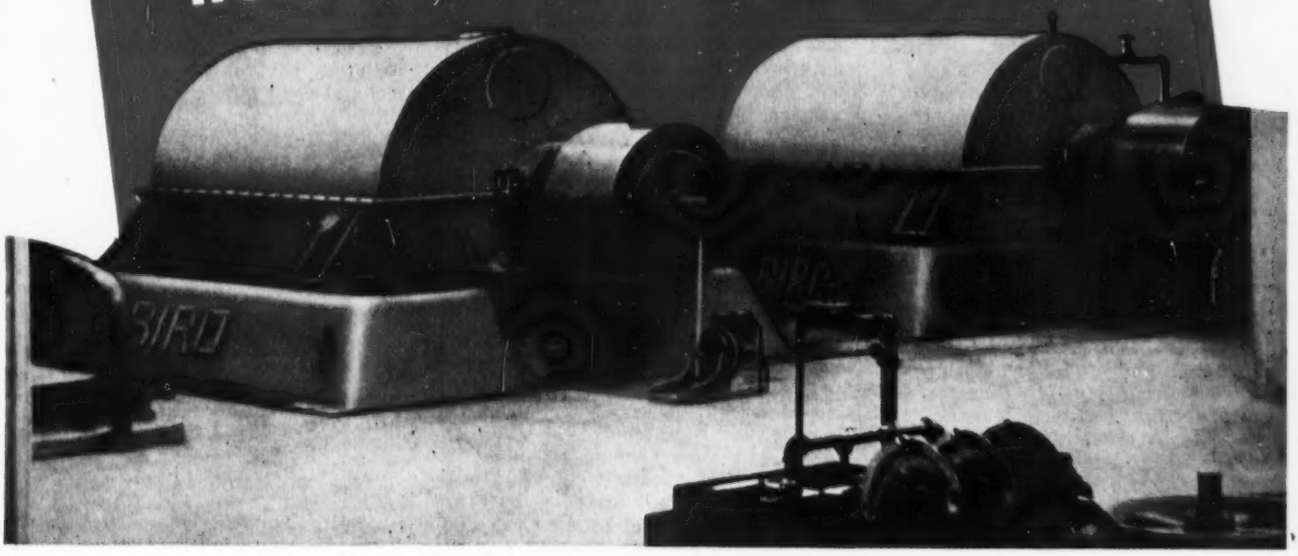
Victor M. López has been to Trinidad, B.W.I., as member of a commission of four Venezuelan engineers to work with a similar British commission on a survey to establish the submarine limits in the Gulf of Paria between the island of Trinidad and Venezuela. This is of great interest to both countries because of the possibility that petroliferous sediments extend into the Gulf.

John C. Davey has returned from a two months' survey of the Venezuelan gold and diamond fields on the lower Caroni River and in the Gran Sabana region. He will report to the Venezuelan government and is expected to make recommendations which should result in better operating conditions and lower costs on these fields.

Philip S. Smith, for more than 20 years chief Alaskan geologist of the U. S. Geological Survey and a member of that organization for more than 40 years, retired from Government service on March 31. In addition to his long term of duty in Alaskan field work, Mr. Smith was for 10 years administrative geologist of the Survey. His address is 3249 Newark St., Washington 8, D. C.

Harlow D. Phelps, mining engineer and U. S. mineral surveyor, has opened an office for general engineering practice and consulting work at 532 East

Two BIRDS like these are saving close to fifty cents a ton of reagent cost on a desliming job, handling nearly 500 tons a day



Think what that means per year! The machines are paying for themselves many times over on an operation involving non-metallic minerals.

Why not find out what the BIRD can do for *your* flotation feeds.

Bird Machine Company, South Walpole, Massachusetts.

The BIRD Centrifugal CLASSIFIER

First St., Tucson, Ariz. Mr. Phelps is a graduate of the Colorado School of Mines and has had extensive experience in mining in Colorado, California, and Alaska.

D. A. B. Watson who has been general manager of Government Gold Mining Areas, in the Transvaal, for the past four years, has taken up a position in the head office of the Barnato group in Johannesburg. He is succeeded at Government Gold Mining Areas by **J. W. Jack**, who has been manager of New State Areas, also in the Transvaal, for several years. **R. S. Cook** succeeds J. W. Jack as manager of New States Areas.

H. Nellems, who was assistant manager of the Sub Nigel, in the Far East Rand, has been appointed manager of Venterspost Gold Mining Co.; and **C. L. Prahm**, previously manager of Venterspost has been appointed manager of Libanon Gold Mining Co., Ltd., Western Rand.

W. E. Sinclair has resigned his position as manager of the Bultfontein mine (De Beers Consolidated Mines) to assume a new appointment as manager of the Cape Asbestos Co., Cape Colony.

Maurice F. Dufour has been named general manager of Nicaro Nickel Co., a susidiary of Freeport Sulphur Co. He will continue to reside in Cuba, where Nicaro operates mines and a concentrating plant.

William A. Riggs, who for the last 2½ years had been serving as an officer in the U. S. Naval Reserve, has been appointed industrial geologist for the Atlantic Coast Line Railroad Co., with headquarters in Wilmington, N. C.

Edward Thornton, of the Union Engineering Co., of Los Angeles, has returned from a trip to western Arizona, where he examined a gold mine, and left before the first of April on an examination trip to Honduras.

Lieut. Forrest L. Bradfield, Jr., who spent three and one-half years in the Air Corps—having seen one year in the China-Burma-India theater—is now with the Combined Metals Co., at its Pioche, Nev., mines. He is a graduate of the Arizona School of Mines.

Dr. Charles E. Bunnell, president of the University of Alaska, recently made a trip to Washington, D. C., in connection with a bill which has been introduced in Congress that proposes the erection of a geophysical building on the University of Alaska campus.

Vernon Rogers, who has been chief engineer for the Climax Molybdenum Co. at Climax, Colo., has gone to Boron, Calif, to become mine superintendent for the Pacific Borax Co.

Adolph Poston, of Denver, has purchased the Cripple Creek assay office of P. B. Van Dolah, and will operate it as Poston Assaying Co. The office is that originally owned by Joseph B. Page, who operated through the great days of the camp and until his death in 1938. Poston, a graduate of Colorado A. and M., has been in assay work in Denver.

Urpo Kyto, of Duluth, Minn., president of the Champion City Mines, Inc., has been at the company's formerly productive Lucky Boy silver-lead mine near Hawthorne, Nev., where early resumption of deep-level development and operation of a 250-ton flotation mill are in prospect.

Charles A. Liddell, veteran Nevada mining engineer, in Government service during the war, has returned to his Mina, Nev., headquarters and has undertaken reopening of the once-productive New Pass gold-silver mine, in western Lander County, Nev.

G. H. Griffin, general superintendent for Electro Metallurgical Corporation at the magnesium reduction plant at Mead, Wash., has been transferred to Portland, Ore., where he is still associated wtih Union Carbide & Carbon Co.

C. C. Cushwa, until recently manager of the Spring Hill mine, at Grass Valley, Calif., has been appointed superintendent of the Ancho Erie property, near Washington, Nevada County, succeeding **Fred Anderson**. Mr. Anderson plans to devote most of his time to other company holdings.

Dr. Willard H. Dow, of the Dow Chemical Co., Midland, Mich., was recently appointed a member of the Board of Control of the Michigan College of Mining and Technology at Houghton by Governor Harry Kelly. The college has long recognized Dr. Dow's qualifications and eminence in his field and in 1939 conferred upon him the honorary degree of Doctor of Science.

Roy A. Young, a former resident of Marquette, Houghton, and Calumet, Mich., has been elected a member of the board of directors of the Calumet & Hecla Consolidated Copper Co. Mr. Young, formerly head of the Federal Reserve Bank, is president of the Merchants National Bank of Boston.

Arthur D. Storke, mining engineer, will succeed **Max Schott** as president of Climax Molybdenum not later than June 30, 1946. Mr. Schott is retiring as of April 4, 1946.

Ralph E. Sinke has arrived in British Guiana to assume direction of Cuyuni Goldfields, Ltd. Mr. Sinke is a graduate of Colorado School of Mines.

R. Crowe-Swords, president and managing director of the Santiago Mines, Ltd., has been elected president of Golden Slipper Mines, Ltd., and of Santiago Alaska, Inc. **Einar W. Ericksen** has been engaged as consulting engineer by the last-named company.

Dr. W. E. Cockfield, chairman of the B. C. Section of the Canadian Institute of Mining and Metallurgical Engineers, has been designated a senior geologist by the Department of Mines and Resources, Ottawa.

E. E. Mason has gone to Barkerville, B. C., to direct development work at the Cariboo-Hudson mine.

S. G. "Pat" Behnsen has returned from British Guiana, where he was in charge of diamond drilling for Cuyuni Goldfields, Ltd.

Phil J. Shenon, a native son of Idaho, who recently concluded service of several months in the Pacific area as a geologist in the intelligence office of the Army, and who was previously in charge of the Spokane regional office of the U. S. Geological Survey, has established a private practice in Spokane, Wash.

A. J. Keast, chief general manager in charge of mines and works of Zinc Corporation, Ltd., and New Broken Hill Consolidated, Ltd., Broken Hill, New South Wales, has been elected president of the Australasian Institute of Mining and Metallurgy for 1946.

J. J. Fox, lately general manager of Lancefield Gold Mines, has been appointed general manager of Hill 50 Gold Mines, N. L., at Mount Magnet, Western Australia.

Frank R. Begg has been appointed assistant general manager of New Occidental Gold Mines, N. L., Cobar, New South Wales.

Charles F. Willis, editor and publisher of the Phoenix, Ariz., *Mining Journal*, since 1920, has sold that magazine to Miller Freeman Publications, of San Francisco and Seattle, Wash., publishers of the *Mining World*, with which the first-named publication will be consolidated. Mr. Willis has been made secretary of the Arizona Small Mine Operators Association.

Alfonso Guzman da Silva, formerly with Bunker Hill & Sullivan at Kellogg, Idaho, has gone to Peru to join Cerro de Pasco at La Oroya as ore-testing engineer.

A. W. Tolonen, recently with the U. S. Bureau of Mines, has accepted the post of chief engineer with South American Development Co., Apartado 655, Guayaquil, Ecuador.

H. A. Ellis has been made Government Geologist of Western Australia.

Stuart S. Pullar has joined the staff of Mt. Morgan, Ltd., Mt. Morgan, Queensland, Australia, as smelter superintendent.

E. H. Snyder, of Salt Lake City, president of Combined Metals Reduction Co., has been elected president of the Utah Metal Mine Operators Association.

C. R. Kuzell has been elected president of the Arizona Section of the A.I.M.E. He is the assistant manager of the Phelps Dodge Corporation smelter at Douglas, Ariz.

Dr. H. T. James was recently elected president of the Mining Association of British Columbia for 1946.

Lyle M. Barker has been made manager of the Morenci, Ariz., branch of Phelps Dodge Corporation, after having held a similar position at the New Cornelia branch of the company at Ajo, Ariz. **Ernest Wittenau**, recently at Morenci as general superintendent, has been transferred to New Cornelia, and **Walter C. Lawson** becomes general superintendent at Morenci. **G. C. Davis**, manager at Morenci, will direct labor relations at Douglas, Ariz.

Arthur Letts, Jr., president of **M. G. L. Mining Corporation**, operating at Fernley, Nev., announces the removal of his offices to 10236 Charing Cross Road, Los Angeles, Calif.

J. H. Vose, Jr., recently at the El Paso unit of A.S.&R. as metallurgist, has gone to South Africa to become assistant smelter superintendent for O'Okiep Copper Co., Ltd., at Nababeep, Namagualand.

Richard J. Ennis has succeeded **Alan E. Cameron** as president of the Canadian Institute of Mining and Metallurgy. Mr. Ennis is general manager of McIntyre Porcupine Mines, Ltd., Schumacher, Ont.

OBITUARIES

William H. Pitts, 60, mine superintendent of Amalgamated Pioche Mine & Smelter Corporation, Pioche, Nev., died Feb. 26 in Salt Lake City.

Howard R. Ward, well-known mining engineer, assayer, and senior partner of the firm Ward & Ward, of Auburn, Calif., died on Jan. 20 in Sacramento, Calif., at the age of 64.

Edwin John Longhurst, 81, veteran prospector and shift boss, died March 5 in Salt Lake City.

William Arthur Butchart, who 35 years ago perfected the concentrating table bearing his name, and inventor of the Butchart flotation machines, died recently in Rogers, Ark.

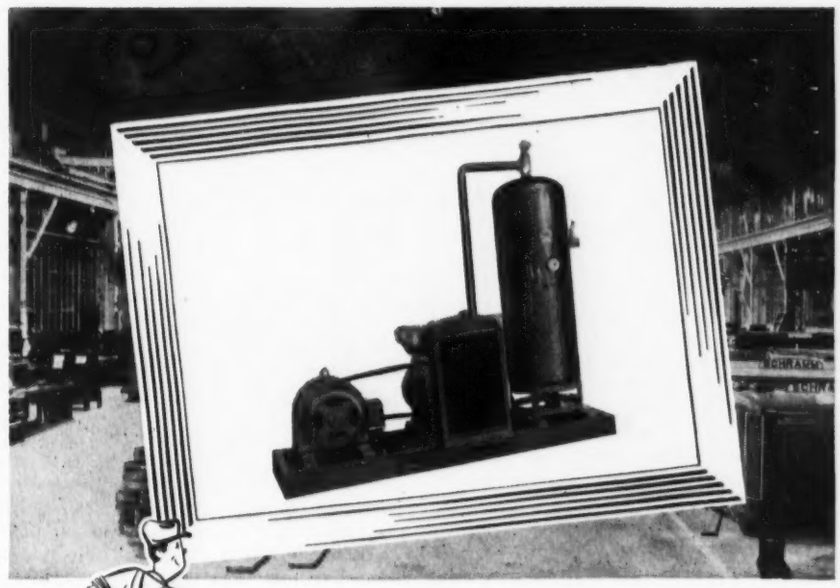
Henry McSweeney, president of the United States Potash Co., and a pioneer in the development of potash deposits in southeastern New Mexico, died in Atlantic City, N. J., on March 5 at the age of 91.

William Robbins, 74, former mine superintendent, died Feb. 19 in Salt Lake City.

Arthur I. Reynolds, a United States mining man who went to the Philippines in 1904 and who was engaged thereafter until 1941 in the gold fields around Baguio, in prospecting for iron and gold, and in the development of the Philippine lumber industry, is reported to have been executed by the Japanese in March, 1942.

John Palecek, formerly mill superintendent for Keystone Copper Corpora-

(*Continued on page* 152)



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NEW BOOKS

ONE WORLD OR NONE—A SYMPOSIUM. McGraw-Hill Book Co., Inc., New York, 1946. Pp. 79. Price $1.

This well written and conceived symposium by an impressive group of scientists and writers competent to discuss the atomic bomb and its consequences is a "must" for people who want a clear conception of the new weapon and the radical changes in human behavior necessary to prevent the wreck of civilization.

The work graphically describes the destruction at Hiroshima and what would happen if our own great cities were blasted. It emphasizes the complete impossibility of control by nationalistic methods and the absolute necessity of establishing effective international surveillance and control if the annihilation of civilization is to be avoided.

WHEN FOREMAN AND STEWARD BARGAIN. By Glenn Gardiner. McGraw-Hill Book Co., Inc., New York, N. Y. Pp. 188. Price $2.

After reading the 188 pages of "do's" and "don'ts" in Mr. Gardiner's book, we are inclined to think that foremen have the toughest jobs in the business. Apparently, to be a good foreman these days one has not only to know the technical details of the job but also to act like a combination of Dale Carnegie, the twelve Apostles, and a State Department career man. A foreman isn't what he used to be, and this book proves it.

The fact is plain enough that supervisors have got to adjust themselves to the increasing complexities of unionized industry, and Mr. Gardiner's advice on getting along with union stewards will greatly ease that difficult process. The book is rather too concentrated a dose to absorb in an evening or two, however, and the greatest good could probably be obtained if it were used as a textbook supplementing discussion in a supervisors' training course. In any event, there is much material here that every supervisor ought to read and to think about.

R.H.R.

GEORGE WESTINGHOUSE — HIS LIFE AND ACHIEVEMENTS. Westinghouse Electric Corporation, East Pittsburgh, Pa. Pp. 36.

The current year is the centennial of the birth of Westinghouse, whose achievements have played so great a part in building the world of today. They are summarized in this attractively illustrated pamphlet. Within the span of his life of 68 years, stretching from 1846 to 1914, the great inventor took out not fewer than 361 patents, the first of which was issued shortly after his nineteenth birthday. To quote from the biographer: "His inventions hastened the growth of the railroads. . . . He devised the first effective means for stopping trains—the air brake; he pioneered in the development of railway signals and interlocking signals; he invented a safe and efficient mechanism for joining railway cars; he brought out the first mainline electric locomotive and was a pacemaker in modern railway electrification. . . . He developed a system for transmitting and using natural gas, and topped this with perhaps his greatest contribution of all—today's alternating current system of generating, transmitting, and utilizing electricity for power and light.

"To modern world commerce he gave a perfected steam turbine geared to drive ships, and with this paved the way for the development of powerful present-day fleets.

"Westinghouse was not only an inventor—he built what he invented. . . . he formed and directed more than 60 companies to implement his ideas."

LABOR POLICY OF THE FEDERAL GOVERNMENT. Harold W. Metz. The Brookings Institution, 722 Jackson Place, Washington 6, D. C. Pp. 275. Price $2.50.

To our way of thinking, this factual account of the growth of the weird hodge-podge called Federal labor policy makes better reading than *Forever Amber*. In fact, this reviewer lost interest in the improbable Miss Amber about halfway through the book, but his interest in Mr. Metz's facts never flagged. One does not, after all, lose interest in something violent that is being done to him, and there is plenty of such violence recorded in this book.

Mr. Metz claims he wrote the work with no attempt to evaluate the desirability of the Government's several objectives in its labor policies. He does, however, point out some inconsistencies, and he also tries hard to find some consistency in the "piecemeal" policies, to which he also points. Though his book was written unemotionally, it can hardly be read without emotion.

Set forth in cool and precise detail is the record of the violence done in many cases by the idealists of the NLRB to the rights of employers and of unorganized employees. This reviewer could scarcely believe that some of these things actually happened, that a Government agency could so easily flout accepted standards of morality in gaining not alone the stated objectives of the Wagner Act but its own version of those objectives. Perhaps the tactics of the NLRB were necessary to help labor to its feet in this country, but we will be hard to convince on that point.

Also, you will read of the development of policy that has given labor impunity before the law for acts that would earn the unorganized citizen a prison sentence. If you feel an urge to commit assault and battery, extortion, theft, or property destruction, this book will tell you why, and under what circumstances, you can get away with it if you belong to a union.

Mr. Metz and the Brookings Institution are to be congratulated for this work. Even if this book alone were used as a basis, a group of intelligent informed men could still, working independently of pressure groups, formulate a coherent equitable Government labor policy.

R.H.R.

ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION. For Sale by Superintendent of Documents. Pp. 503. Price $1.50.

The so-called "General Appendix" of the annual report of the Smithsonian's Board of Regents customarily constitutes the larger part of the book and is its most interesting section, from the reader's viewpoint. In the latest volumes, that for 1944, just received, the appendix occupies 385 pages out of the total of 503. The remainder constitutes the "report," itself containing considerable meat. Twenty-three articles, some covering discoveries in various branches of science with a not too technical treatment, are comprised within its limits. Two of these in particular would draw the eye of engineering readers—one is entitled "The New Microscopes," and deals with the electronic microscope, about which much has been written, and the "universal" microscope, developed by Dr. R. R. Rife and possessing a resolution of 31,000 diameters and a magnification of 60,000 diameters. The other article, by Wallace E. Pratt, of Standard Oil Company of New Jersey, deals with our petroleum resources.

HOW TO HANDLE COLLECTIVE BARGAINING NEGOTIATIONS. National Foremen's Institute, Inc., Deep River, Conn. Pp. 38. Price, $5.

A manual of advice to management on the best methods of conducting collective bargaining negotiations, this pamphlet was prepared by a group of "bargaining experts" in collaboration with the staff of *Executive's Labor*

Letter, 527 Fifth Ave., New York 17, N. Y. Some of the information offered seems rather elementary and obvious, but the greater part of the material should be of value, at least to any organization that does not now possess the services of a thoroughly experienced negotiator. Many typical clauses are analyzed, and procedures are suggested for avoiding pitfalls and for gaining desired points. The theme is stressed that bargaining is no more than a business deal which should be conducted fairly and firmly but without diffidence or undue generosity. As the manual points out, "collective bargaining is no game for amateurs."

FIFTIETH ANNIVERSARY NUMBER, COMPRESSED AIR MAGAZINE, March, 1946. Phillipsburg, N. J.

Unusual interest for the mining man attaches to the March issue of this magazine by reason of the fact that the editors have chosen to signalize its fiftieth anniversary by devoting the entire editorial contents to historical material. So much of the history of mining is linked up with the history of compressed air and the development of compressors and blowers, rock drills, pneumatic tools, and the air lift, as well as of air conditioning and mine ventilation, that perusal of the facts and dates set down serves to stimulate the search for further information. Outstanding among the articles are "Compressed Air Cavalcade," "Development of the Compressor," "Rock-Drill High Lights," and "Tunneling Through the Ages." Congratulations to the editors!

PUBLICATIONS RECEIVED

Building-Block Materials of Eastern Oregon. By Norman S. Wagner. Short Paper No. 14. Department of Geology and Mineral Industries. Portland, Ore. Pp. 6. Price 10c.

A List of 137 Foreign Scientific and Technical Periodicals. Published during war years from 1939-40 to recent date. Available in reprints. J. W. Edwards, publisher, Ann Arbor, Mich.

California Journal of Mines and Geology. Vol. 41, No. 2, April 1945, contains an article entitled "Quicksilver Deposits of the Knoxville District, Napa, Yolo, and Lake Counties, California," by Paul Averitt. The principal article in the following number of this quarterly, that for July 1945, is entitled "Mineral Resources of Riverside County, Calif," by W. B. Tucker and R. J. Sampson. The bulletin is published by the California Division of Mines, San Francisco, and sells for 60c. a copy.

Geology and Manganese Deposits of Northeastern Tennessee. Bulletin 52, Division of Geology, Nashville, Tenn. Pp. 275. Plus maps.

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REGIONAL NEWS

IDAHO

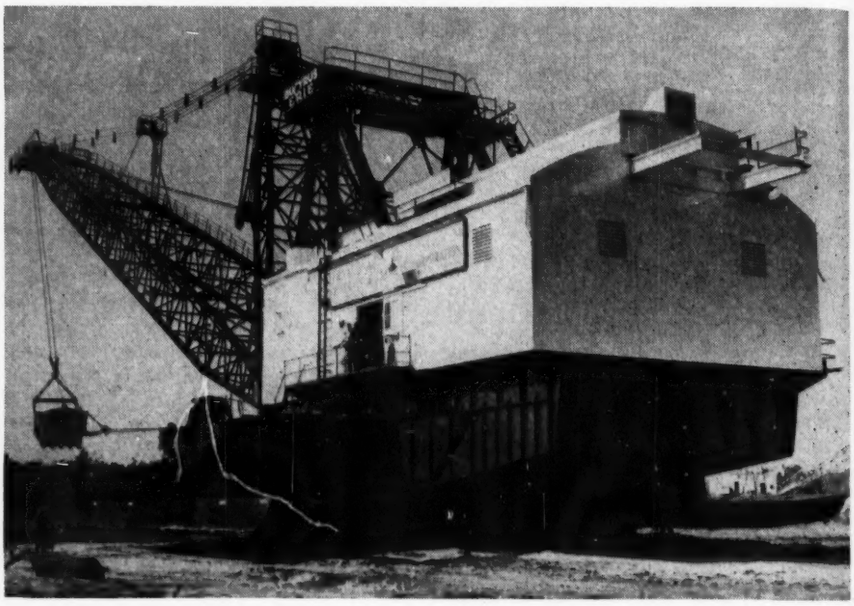
Sunshine report reviews Chester vein developments—New lead-zinc district in Boundary County

★Sunshine Mining Co. has announced its first quarterly dividend of 10c. a share for the year 1946, amounting to $148,882 and payable March 30 to stock of record March 1. This brings Sunshine's total dividend record to $25,285,181.

Ross D. Leisk, manager, says in the company's annual report that the orebody on the 3,700-ft. level in the Chester vein has been proved for a length of 950 ft., 388 ft. of which is in the Omega area, jointly owned by Sunshine and Polaris Mining companies, and 562 ft. in the Rotbart area, which is divided equally among Sunshine, Polaris, and Silver Dollar. The average width of the ore is 4 ft. and the average silver assay 64 oz. per ton. The lead content was extremely low—less than one-half of 1 percent.

"The most important development of the year," says Leisk, "was the discovery of lead-silver ore in the Silver Syndicate fault zone on the 3,700-ft. level at a point 350 ft. due north of the Jewell shaft in territory in which Sunshine Mining Co. and Silver Syndicate, Inc., have equal interests. The ore has varied in width from a few inches up to 12 ft. in a length of 169 ft. explored by drifting up to the end of the year. The average width for this length was 4.2 ft. and the average assays for the samples cut were 47 oz. of silver and 22 percent lead. This discovery opens up interesting exploration possibilities on account of its great distance from any previously known ore occurrence."

Mr. Leisk also mentions in the report that "A new agreement was concluded with the Metropolitan Mines Corporation, Ltd., which settled questions of ownership of ore in the Yankee Girl vein within Metropolitan boundaries on the basis of 84 percent to Sunshine and 16 percent to Metropolitan. The agreement also completed the acquisition by Sunshine of a 50 percent interest in all other mineral holdings of Metropolitan. Through a working agreement concluded in December, Sunshine has acquired a 50 percent interest in the mineral holdings of the Big Creek Apex Mining Co. This property lies immediately west of Sunshine's holdings and north of the Sunshine Consolidated," in which Sunshine also holds a 50 percent interest. These various interests give Sunshine six different known orebodies to draw from. The company has not been working at capacity, however, since the beginning of the war in 1941, partly because of supply conditions but mostly because of the labor shortage.



THE CAPACITY OF THE BUCKET of this dragline used to strip overburden at the Peace Valley property of the International Minerals & Chemical Corporation in Florida is 21.4 cu.yd., or 64,200 lb. of rock. Other facts are: length of boom 215 ft., bucket per hr. 60 to 75, total weight 2,571,000 lb., size of shoes 9x54 ft., diameter of tub 50 ft., walking speed 0.11 miles per hour, largest rope diameter 2¼ in., combined horsepower 1,750.

★Byron Wilson, mining engineer long connected with the Hecla Mining Co., has taken charge of the Clayton Silver mine, near Clayton, Idaho, succeeding C. A. Fay, who has returned to the Coeur d'Alenes to look after other mining interests.

★The University of Idaho Bureau of Mines and Geology has employed airplane, car, horse, boat, and foot travel in a geological study of a rugged area of Idaho lying between the Salmon and Snake rivers, from the small settlement of Riggins to the junction of the two rivers. The bureau assigned Warren G. Wagner, geologist, to the task, and his report has been published by the University as Bureau Pamphlet No. 74. In this pamphlet Wagner states that the territory studied represents about 530 square miles. On the east the unexplored area borders on one of Idaho's famous early-day gold-producing regions, the Salmon River country, whose placers produced millions of dollars in gold and, according to Wagner, still offer possibilities to the placer gold miner. "Placers from Riggins to Whitebeard," he says, "offer the best opportunity for placer mining in the district. Some of the deposits, particularly the higher bench gravels, have had very little work done on them."

★At Silverton Mines Co. property on Revenue Gulch northwest of Wallace, the company has completed driving a crosscut tunnel 686 ft., crossing a mineralized area which the company is now diamond drilling with the idea of prospecting the mineralized zone at a depth of 1,000 ft.

★Lucky Friday Silver-Lead Mining Co., operating in a heretofore unexplored mineral belt between the Osburn and White Ledge faults at Mullan, has received net smelter returns of $16,066.96 for 60 tons of silver-lead concentrate shipped to the A.S.&R. East Helena smelter and 27 tons of zinc concentrates shipped to the Sullivan zinc plant, at Kellogg. The silver-lead concentrates averaged 308 oz. of silver and 41 percent lead per ton. The ore, as sent to the Golconda custom mill, was classed as "development rock," having been produced in driving a prospect drift on the vein on the 1,000 ft. level. Similar shipments have been made from higher levels, all of which total $206,521.79. No stoping has been done between the 1,000 and 800-ft. levels. Instead of commencing production, the company has continued its

main shaft on down to the 1,400-ft. level, from which point a crosscut is now being driven to the vein. The company has recently installed a larger electric hoist, equipped its haulage tunnel with 40-lb. rail, and installed an air compressor underground.

★At the annual meeting of the Silver Dollar Mining Co., which was held in Wallace in February, the directors reported that during the year the company had made net profits of $41,373.60 from its one-third interest in the "Rotbart" section of the Chester oreshoot operated by the Sunshine and Polaris mining companies. The "Rotbart" area comprises 550 ft. in length along the Chester vein, and production from this area in 1945 totaled 31,668 tons from the 2,700, 2,900 and 3,100-ft. levels, and the metals recovered totaled 575,400 oz. of silver, 790,500 lb. lead, and 149,500 lb. of copper.

★The Bradley Mining Co., operating gold, antimony, and tungsten mines at Stibnite and Patterson, is establishing a new mining camp at Mogollon, N. M., with T. A. Monahan in charge as engineer and general manager.

★Sidney Mining Co., operating on Pine Creek, has completed four raises connecting Nos. 5 and 3 mine levels along 600 ft. in length of an orebody which has developed 15 to 20 ft. wide of lead-zinc ore. The raises are in preparation for stoping operations to supply a 250-ton milling plant now nearing completion. The Sidney oreshoot has been proved by drifting for over 1,000 ft. and is high-grade mill feed in both lead and zinc content.

★Hecla Mining Co. has declared its first quarterly dividend of 25c a share for the year 1946, totaling $250,000 and payable March 15 to stock of record Feb. 15. This brings Hecla's total dividend record to $29,155,000.

★Spokane-Idaho Mining Co., operating on Pine Creek, has completed its shaft development from the 900 to 1,000-ft. level, from which point stoping operations will be started. The vein was crosscut on the 900 level, where it showed a 7 ft. width of high-grade zinc-lead ore. The company now employs 60 men, against a wartime crew of 12 men, and is handling 150 tons per day in the mill. The company's ore vein differs from all other Pine Creek deposits in that the strike of the vein is north and south, whereas all the others are east and west.

★The Bradley Mining Co. is remodeling its 2,000-ton capacity milling plant at Stibnite, changing from a tungsten concentrating mill to a gold and antimony plant. The tungsten deposit has been exhausted.

★Daylight Lease Co. has suspended production operations at the old Interstate Callahan mine, north of Wallace, after producing a large tonnage of zinc-lead ore from a large "pocket" in the Nipsic vein.

★Howe Sound Mining Co. has pur-

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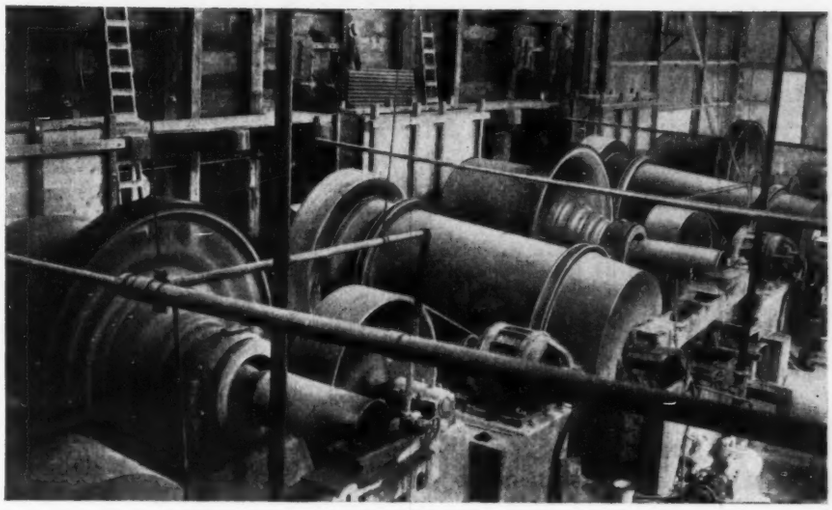

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Idaho *(continued)*

chased a group of cobalt-gold-copper mining claims in the Blackbird mining district in the Salmon River country of Idaho, near Fourney, and is now moving in heavy machinery for extensive mining and milling operations. The company has been prospecting the property for the last year and has completed a large amount of underground development on what is said to be the largest known deposit of cobalt mineral in the United States.

★Alfred L. Anderson and Warren R. Wagner, geologists associated with the University of Idaho School of Mines under Dean W. H. Fahrenwald, have announced the discovery of a new mining district in Idaho that contains the same type of silver-lead-zinc ore deposits as those of the Coeur d'Alene district. The new district is in the Purcell Mountains in Boundary County, about 14 miles by road northeast of Bonners Ferry. Geologists call it the Moyie Yaak district. The mineral deposits are described as fillings and replacements along high-angle reverse faults in the granite rock of the Nelson batholith, and contain, in addition to lead and zinc, appreciable quantities of silver and gold. The lead and zinc are associated with siderite and the gold occurs with arsenopyrite. The Moyie Yaak district was practically unprospected territory up to 1936, at which time the Silver Crescent Mining Co. opened what is known as the Regal mine, built a mill, and started shipping lead and zinc concentrates. Production from this operation is about 90 tons of lead concentrate and 30 tons of zinc concentrate monthly.

MONTANA

Anaconda to provide clubhouses for employees—Last Chance Gulch Association elects officers

★Anaconda Copper Mining Co. is preparing new clubhouses for its employees in both Butte and Great Falls. The new recreational centers will be given as memorials to the many employees who entered the armed forces and to those who remained on the job during the war. It is planned to build the Great Falls clubhouse near the golf course at the smelter. The Butte recreation hall will be in the old Thornton Hotel building, which is being renovated for the miners. Preliminary plans are also under way to give the smelter workers at Anaconda a similar recreation center.

★The Sullivan mine, owned by State Senator M. J. Sullivan, of Jefferson County, will be operated by the Aldirey Mining Co., with headquarters at Alhambra. The company is installing new machinery. Officials of the company are A. B. Dirks, of Great Falls; Frank Humphrey, of Lovelock, Nev., and Leo Hansen, of Great Falls.

★The Last Chance Gulch Mining Association held its first spring meeting recently in Helena, to elect officers for the coming year. As a result of the election, E. J. Keeley, president, Ed. Maronick, and Arthur Dryer were replaced by Gailen T. Vandel, president, Norman Thompson, and William R. Wade; and C. R. Brazier, vice president, and Hugh K. Gaw, secretary and treasurer, were reelected to office. For the first time the association also elected an advisory board composed of August Grunert and E. J. Keeley, of Butte; E. B. Coolidge, of Great Falls; Fred Bleck, of Virginia City; and E. G. Toomey, Howard Walden, and G. A. Porte, all of Helena. Ed Keeley, who has been president of the organization for three successive years, was complimented for outstanding achievements during his tenure of office.

★The Ohio Keating mine, in the Radersburg district, recently resumed operations. Pete Mosier, who formerly operated the property, is again in charge and is conducting rehabilitation work, including pumping and retimbering. The 100-ton mill, which produces gravity concentrate from which the gold is removed by the cyanide process, will be made ready for operation in the near future. The ore is a heavy gold-bearing sulphide.

★The Boulder mine, situated in Jefferson County, a short distance north of Basin, is being operated under lease by James P. Bragg. Bragg was superintendent of Basin Goldfields, Ltd., prior to more recent service in the U. S. Army at Panama.

★The Big Ox property, in the Marysville district, was recently leased to Frank Staral, of San Francisco, and James B. Meikle, of Cleveland, Ohio. The new operators plan to explore the property and equip the mine for operation if results are favorable.

WASHINGTON

Kaiser-Frazer company to operate Trentwood plant — Howe Sound negotiates operating loan

★Henry J. Kaiser interests acquired in February a five-year lease, assigned by the War Assets Corporation, on the two aluminum plants adjacent to Spokane. Kaiser-Frazer, Inc., will operate the Trentwood rolling mill (chiefly for production of aluminum auto bodies, it is believed), and Kaiser Cargo, Inc., will operate the Mead plant.

Under the lease, Kaiser-Frazer, Inc., is required to pay taxes, insurance, and maintenance, and graduated rentals, on the Trentwood mill, ranging from $250,000 per annum, or 5 percent of the gross sale of the product of the plant

for the first year, whichever is higher, up to $2,667,000 for the fifth year, per annum, provided, if its rentals for the first four years paid to the government are less than $10,668,000, Kaiser shall during the fifth year pay 5 percent of the gross sales of the plant during that year if such 5 percent is greater than the $2,667,000 up to an amount equal to the difference between the rentals actually paid and the $10,668,000.

Kaiser Cargo, Inc., is required to pay taxes, insurance, and maintenance on the Mead plant, and the terms of the lease call for a five-year period with provision that it be terminated by the company after the end of the second year upon six months' notice and that Kaiser shall be privileged to renew the lease for two more years if the company gives notice of its intention six months before the expiration of the original lease. Graduated rentals on this plant shall be paid monthly in advance at the following rate: "$208,000 the first year when two potlines are available, up to $728,000 for the fourth year when four potlines are available, and $1,248,000 for the fifth and succeeding years when six potlines are available."

Silver busbars, worth $30,000,000, serving four potlines at Mead, will be removed from the plant and will be replaced by copper or aluminum. The Kaiser Co., under its lease, will begin operation on two other potlines.

★Ninety-five percent of the lead and 99 percent of the zinc produced in Washington in 1945 came from five concerns, according to a U. S. Bureau of Mines report. American Zinc, Lead & Smelting Co., which operates the Grandview mine, in the Metaline district, was the leader in both zinc and lead. The four other companies were the Pend Oreille Mines & Metals Co.; the Howe Sound Co., which did not produce lead; the Metaline Mining & Leasing Co.; and the Deep Creek mine, in the Northport district. The State production of 7,200,000 lb. of lead and 22,650,000 lb. of zinc was slightly lower than the amount produced in 1944.

★Three hundred miners and drillers went on a sit-down strike for two days in February, at the Howe Sound mine, at Holden, because the Morrison-Knutson drillers said they were not getting enough sugar. It was mutually agreed at a meeting that the Morrison-Knutson drilling contract would be canceled, and that the 65 men sinking a deeper shaft would leave, and the Howe Sound's regular crews returned to work. According to a company spokesman, the strike had no bearing on the current negotiations between the company and the union for a new contract. He also said the cancellation of the drilling contract would not slow down production.

★Howe Sound Co., operating the Holden mine, in the Cascades, has negotiated an operating loan up to $4,000,000 from Chase National Bank, of New

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Washington *(continued)*

York, for use if needed prior to Sept. 15, 1947, for the development of its newly acquired properties, to wit: the Blackbird copper-gold-cobalt mine, in Lemhi County, Idaho; the Snow Lake division in Manitoba, and El Carmen, near Botopilas, Chihuahua, Mexico. Money has not been borrowed, nor is any borrowing contemplated during 1946.

CALIFORNIA

State dredging operations increase —Bureau opens 6-ton pilot plant for making alloy steel

★Dredging operations are expanding steadily in the State, with Golden Feather Dredging Co., headed by E. A. Wiltsee, of San Francisco, operating two dragline dredge units on its placer holdings along the Middle Fork of the American River east of Auburn, in El Dorado County. The unit, with a capacity of some 7,000 cu. yd. a day, operated for years near the city of Oroville, Butte County, prior to its transfer to the present site last fall. John Biles is superintendent.

★In the Forest Hill district of Placer County, Robert Bowles has placed in operation a dragline dredge on the Placeritas property, formerly worked by Placeritas Mining Co. and bought by Bowles last summer from W. D. Ingram.

★The San Francisco Chamber of Commerce, after a hearing conducted on March 6 by its Mining Committee, headed by George B. Dodge, adopted a resolution advocating reimbursement for capital and certain other losses sustained by gold-mine owners and operators as a direct result of the WPB Order L-208. Such legislation has been introduced in Congress by Representative Clair Engle, of California, and recently has been the subject of hearings in Washington.

P. R. Bradley, Jr., chairman of the State Mining Board, president of the Mother Lode Mining Association, and a member of the Mining Committee mentioned, attended the hearings and presented the local committee's report to the Chamber Board with Robert M. Searls, mining attorney, another member of the group. According to the report, "gold mining has contributed importantly to the economic growth and welfare of the city of San Francisco. The production of $50,948,485 worth of gold in 1940 in California was followed by the smallest gold production in the State since 1849, the production in 1944 being $4,108,055. Gold operations were closed or curtailed in behalf of the war effort WPB Order L-208, which caused production to decline and caused mine operators and owners to suffer severe losses.

"Gold mining is the only industry which was formally wiped out by WPB regulations, and it sustained losses accordingly. The general resumption of gold mining will be essential as a source of future employment directly in mining operations and indirectly, in communities throughout the State that are dependent on gold mining," the report said.

The resolution adopted calls for relief for gold miners and enactment of legislation as embodied in principle in H.R. 4393 as amended. In brief, legislation is wanted which would reimburse gold miners for capital, maintenance, and rehabilitation losses suffered directly as a result of L-208, but it is not proposed to cover the loss of profits, unpaid owners' royalties, or intangible losses incurred in building up or restoring efficiency of operating organization.

★The pilot plant at Shasta Dam near Redding, Shasta County, sponsored by the U. S. Bureau of Mines to prove the feasibility of producing high-alloy steel from local natural resources and using Shasta Dam power, was opened formally at a ceremony on March 14. The new plant is equipped for the test-production of alloy steel ingots of sizes suitable for rolling and forging in West Coast plants. A direct-arc furnace of the Herault type, with a maximum holding capacity of about 6 tons, has been installed. The furnace is provided with the latest type of automatic control, and is served by a transformer and switchgear with rated capacity of 2,000 kva. Initial work will be undertaken on production of alloys using sponge iron produced from Shasta County magnetite, derived from California manganese ores. William W. Stephens, engineer, is in charge of the plant.

★Yellow Jacket Consolidated Gold Mining Co. is preparing to resume production from its property at Alleghany, Sierra County. The Yellow Jacket mine is equipped with a 40-ton mill, and development work was carried on with a small crew during the last three years. The company also owns the adjacent Osceola property.

★Rehabilitation of the Afterthought copper-zinc mine, at Ingot, Shasta County, is proceeding steadily. The property has been leased recently from the Glidden Co. by Coronado Copper & Zinc Co., controlled by the Mudd interests, of Los Angeles, and Lyttleton Price, mining engineer, is in charge of operations.

★California-Keystone Co. is reported to have completed plans to start hydraulic operations in the spring at its property north of Weaverville, Trinity County. E. F. Trubey is president and general manager, John D. Hubbard, vice president and superintendent, and Ted Gay, attorney, San Francisco, secretary-treasurer.

★S. B. McCluskey, metallurgical engineer, is consultant and general manager of Sierra Mines, Inc., instead

of W. A. Linfesty, who was erroneously reported as consultant for the corporation in a previous issue of *E.&M.J.*

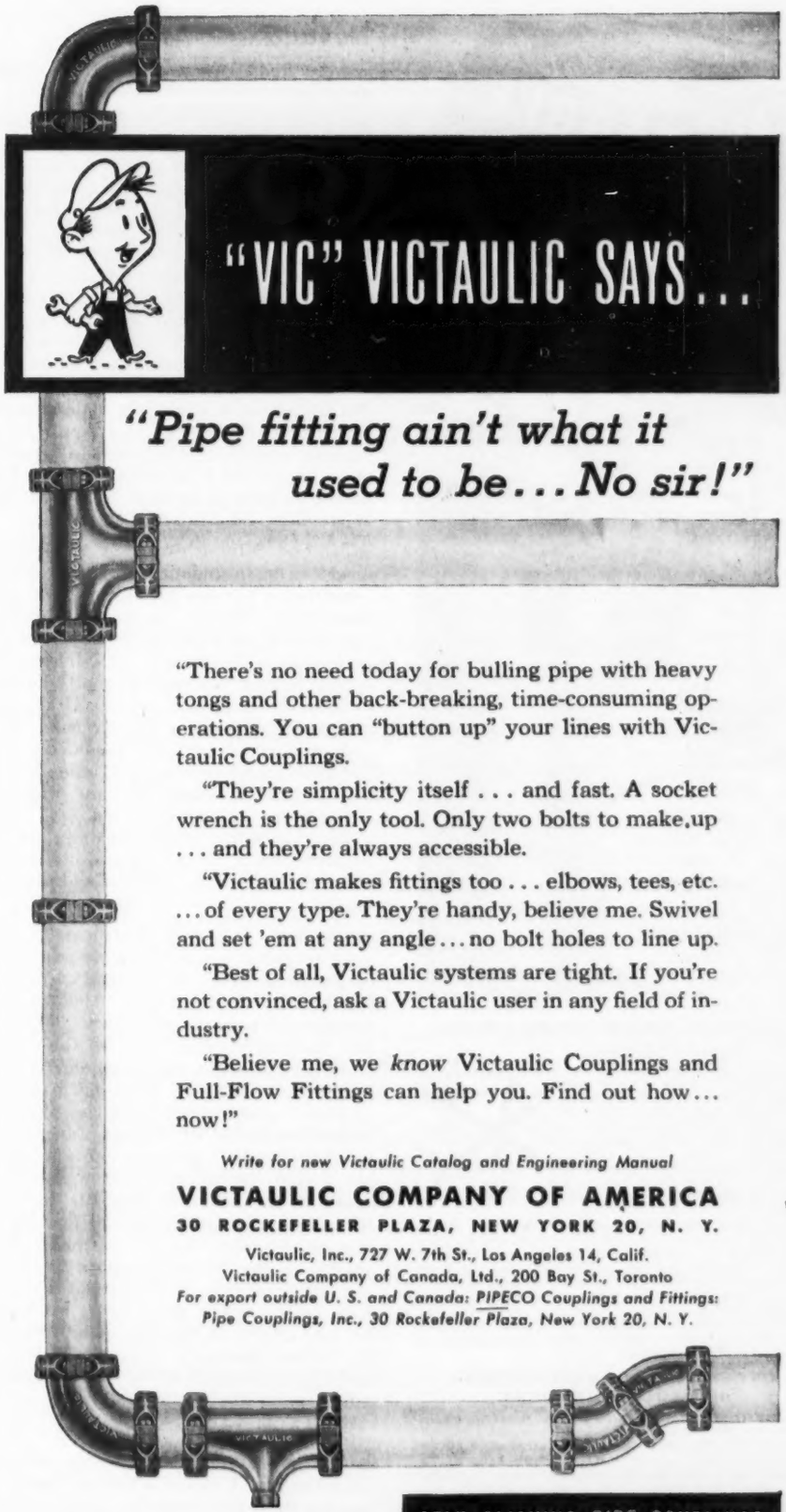
★Vivian Mining Co. has taken an option to purchase the Pine Hill mine, in the Wolf mining district, 15 miles southwest of Grass Valley, Nevada County, from the Red Pine Mining Co. and plans operations as soon as materials and labor are available. The property, which is developed by tunnels, was worked for about two years prior to the shutdown in 1942 brought about by L-208, with production shipped to a custom mill at Grass Valley. Several thousand feet of development work were done at a cost of $30,000 by the Red Pine Mining Co. The Vivian Mining Co. is headed by H. W. Klipstein, of San Francisco, and B. C. Austin, consulting engineer, is managing director and in charge of operations.

★Julian R. Sanchez, owner of United Gold Mining Co., Inc., reports that a development program is progressing satisfactorily. The company controls the Experimental mines and Vine Spring mine, near Columbia, Tolumne County. A good grade of ore has been uncovered at the Experimental mines and is being mined at a rate of about 15 tons per day. Plans are being made to install a Centripact mill for large-scale production soon.

NEVADA

Newmont company explores productive areas—Natomas company to start dragline dredging operations in Landers County

★Newmont Mining Corporation is exploring territory in or near productive districts, admittedly based upon geological and geophysical studies of areas tributary to centers of metal production. Outstanding in Nevada is the project at Goldfield, where prospect drilling was conducted last year. Here the main shaft of the old Silver Pick mine, which adjoins the Mohawk bonanza but was never productive, has been electrically equipped and repaired to the 700-ft. level, with the announced purpose of driving a long crosscut northwest at that depth, toward the area explored by drilling and far beyond the northern limits of early development. Over two miles to the south, Newmont's "Esmeralda Operation," in charge of Fred Wise, formerly superintendent for Getchell Mine, Inc., is sinking an old 60-ft. shaft through detrital material to reach "hard rock" and prospect for the source of a huge boulder of high-grade quartz ore found on the surface. Fred Searls, Jr., vice president of Newmont, in charge of Western mine operations and one-time staff engineer for Goldfield Consolidated Mines Co., has been at the gold camp, where office facilities, electric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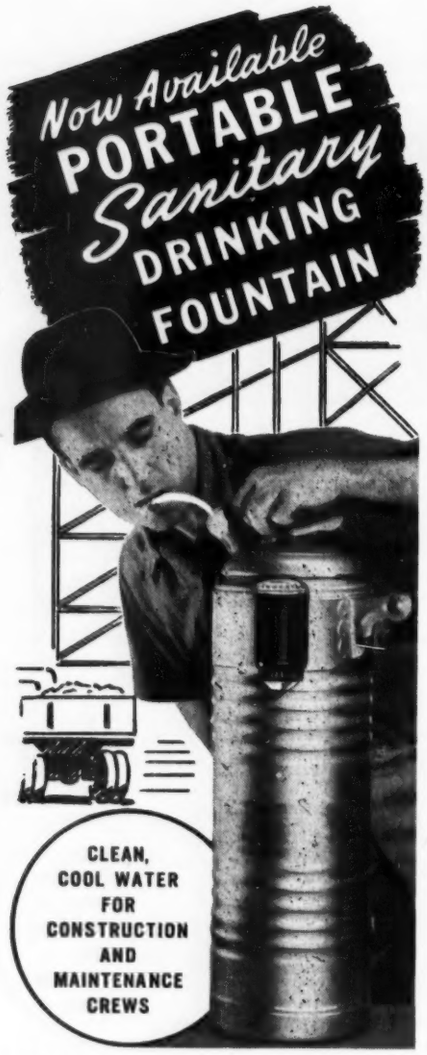

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Nevada *(continued)*

power, and water supply have been provided.

★Eureka Corporation, Ltd., subsidiary of Ventures, Ltd., of Toronto, has provided nearly all surface equipment and power units required in its undertaking to sink its four-compartment shaft on the Fad claim, on Ruby Hill, near Eureka, to a depth of 2,500 ft. to reach orebodies found by deep diamond drilling. George W. Mitchell is directing engineer at Eureka. Sinking, halted last year at 560 ft. when the power plant burned, has progressed below the 750-ft. point and has passed through the troublesome shale into dolomite, in which little timbering is required. Late reports stated that Eureka Corporations had made final cash payment for the large area at Eureka known as the Wittenberg-Cole-Burdick claims.

★Tonopah Mining Company of Nevada directors have announced that plans to construct a 100-ton cyanide mill on the company's Mizpah mine this spring may be long delayed by the shortage of equipment. Production of silver-gold ore by lessees has been virtually halted by a strike of smelter men in Utah, the outlet for Nevada siliceous ores, and the productive Jamesen lease, on the Tonopah Divide property, 6 miles south of Tonopah, is unable to ship some 10 carloads of high-grade gold ore. All plans for mine expansion and plant construction in Nevada are similarly at a standstill because of labor and supply scarcity.

★Natomas Co., second-largest U. S. gold dredging concern, is preparing for operation, with C. E. McKay, of Battle Mountain, in charge, a 5,000-cu. yd. dragline dredge moved from Oregon and assembled, just prior to the issue of Order L-208, at the Greenan Placers property, embracing some 6,000 acres of tested and retested alluvial ground below the outlet of Copper Canyon in Lander County. Natomas officers have announced the purpose to employ the dragline on shallower deposits in and below the canyon and later to provide a connected-bucket dredge of major capacity on the deeper deposits composing alluvial fans that extend in the wide valley to the east. Tests by drilling and shafts to bedrock, conducted by the owner, James O. Greenan, of Reno, and checked by Natomas, have indicated some 60,000,000 cu.yd. of gravel sampling above 20c. per yard.

★U. S. Vanadium Corporation, mining subsidiary of Union Carbide & Carbon, has acquired for operation some of the metal units in the $130,000,000 Basic Magnesium, Inc., plant at Henderson, Clark County, according to H. H. Gillings, manager for the J. M. Montgomery Co., in possession as agent for Defense Plant Corporation. He indicated U. S. Vanadium will process products from mining operations in Humboldt County, Nev., and in California, presumably tungsten concentrate, and that another Union Carbide unit may soon undertake an operation of substantially larger scale. Mr. Gillings said 21,000,000 lb. of metallic magnesium is now stored at the plant, representing two week's production at peak wartime operation.

★The Copper Canyon mine and plant in Lander County which were operated during the war under lease by International Smelting & Refining Co., were relinquished Dec. 1 to the Copper Canyon Mining Co. L. E. Whicher, president, 25 Broad St., New York, has been at the mine and reported that Robert Raring, manager, is installing jig units expected to enable successful treatment of a large volume of oxidized gold-copper ore that has not responded to flotation. A metallurgical laboratory is being provided, the mine crew has been increased lately from 35 to 76 men, and capacity mill operation is expected shortly.

ARIZONA

Mining activities increase in Yavapai County — Attorney General rules on mine inspections

★A. C. Nebeker, field manager for the Arizona Department of Mineral Resources, reports that Charles Brown, an old-time prospector from Prescott, has discovered a gold vein in Yavapai County which has been sampled with encouraging results. Mr. Brown has been prospecting on North Mingus Mountain for ten years. Seven tons of this ore was smelted at Clarksdale and netted $57 per ton.

Mr. Nebeker also stated that Moore & Sons, who have been working the Gladiator Mine, at Crown King, recently opened the largest and best orebody found in the mine. They are now making regular shipments.

★J. S. McClintock, of Crown King, has installed two compressors and a large hoist on the Ore Belle Mine, where extensive development work is under way.

★The Cedar Talisman Consolidated Mining Co., of which J. W. Waters, Jr., is the president, has taken over the French Lilly mine and has started work. The mine is three miles south of Cleator. The French Lilly has been worked the past two years by John Mezik. During that time several carloads of lead-silver-gold ore were shipped to the smelter in Salt Lake City.

★J. O. Braley, of Cottonwood, is working to develop the Copper Point mine, east of Mayer. He is beginning to make shipments to the Clarksdale smelter.

★In southern Yavapai County, George B. Upton has leased his placer and lode north of Stanton to Harry Feick

and Albert Hall, who have heavy equipment for operating the property. Edward Ashurst has begun development of his gold property north of Stanton, and according to Mr. Nebeker, results so far are encouraging.

★Crown Consolidated Gold Mines has filed articles of corporation with the Arizona Corporation Commission. David H. Palmer, of Yavapai County, is president. The Crown Consolidated company will deal in all kinds of mines and mineral lands and will search for new ores and minerals while engaging in regular mining operations.

★Westmont Mining Co. has filed articles of corporation in Arizona. Central offices will be in Prescott. The amount of capital stock is $300,000.

★The state mine inspector of Arizona may inspect any mine operated by its owner, according to a new ruling by John L. Sullivan, Attorney General. Clifford J. Murdock, state mine inspector, was upheld by the ruling in connection with his examination of the Binghampton mine, where he discovered two gasoline engines operating underground and ordered them removed. The owners protested the decision by stating it was unlawful for the inspector to govern regulations of mines employing fewer than six men or where the owners operate the mine.

UTAH

Carbon dioxide causes mine deaths —Petition circulated to oust Reid Robinson

★Reid Robinson, Denver, president of the International Union of Mine, Mill and Smelter Workers, said on March 2 in Salt Lake City that a petition being circulated among union members to oust him from the International Union presidency is "an organizational matter separate and apart from the strike." The petition accuses Mr. Robinson of having solicited a personal loan of $5,000 from an Eastern company with contracts with the union. Kimball Kane, president of Lark local union, said the petition was discussed at a meeting sponsored by the local union on March 2 and addressed by Mr. Robinson. Members expressed confidence in Mr. Robinson's integrity and leadership, Mr. Kane said. Following a meeting of the district union's policy committee on March 4, and the day of Mr. Robinson's departure for El Paso, Tex., Charles R. Brooks, union publicity chairman, said: "All members in good standing have a right to sign the recall petition. If 25 percent sign the petition, Mr. Robinson will be lifted from his office and tried by his own local, which happens to be Butte Miners' local No. 1. This procedure is clearly outlined in the international constitution. The opinion of any union official

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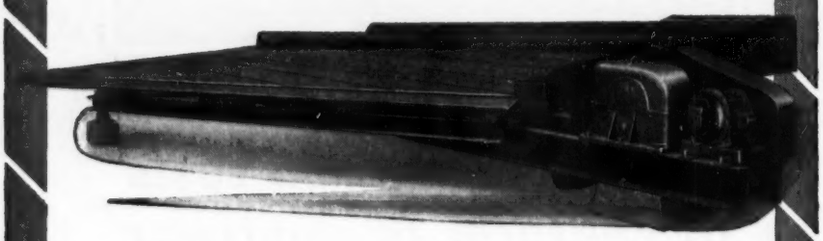

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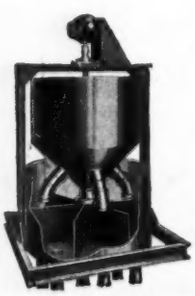

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Utah (*continued*)

can be expressed only through the democratic processes therein described."

★Victor G. Pett, State deputy metal mine inspector, who investigated an accident on Feb. 7 at the Butchman zinc mine, American Fork Canyon, reported that a ventilating fan had been turned off during the night, allowing accumulation of carbon dioxide gas in the mine. Three men were suffocated as a result.

★Eighty miners at Park Utah Consolidated Mines Co.'s Keetley mine failed to go to work March 2 reportedly because a non-union watchman at the mine refused to contribute a $1 per day assessment to a strike fund of the district Mine, Mill & Smelter Workers Union. The contract with the union calls for maintenance of membership and does not require workers to join the union. The men went back to work on March 5.

★Utah's shipments of iron ore in 1945 totaled 1,987,000 tons, compared with 1,542,284 tons in 1944, according to U. S. Bureau of Mines reports.

★Gold Fields Consolidated geologists and engineers are studying the property of the Silver King Western Mining & Milling Co. adjoining that of Silver King Coalition Mines Co., Park City, under an agreement by which Gold Fields Consolidated can develop the mine and acquire its stock at $1 per share. Thomas F. Kearns is president of Silver King Western.

COLORADO

Climax reports reserves—Fires destroy surface buildings at two mine properties

★Results of Climax Molybdenum Co.'s large diamond-drilling program, which was carried on throughout the war, were disclosed in the annual report. Reserves as of Dec. 31, 1945, total approximately 260,000,000 tons of proved and probable ore, containing 1,600,000,000 lb. of recoverable molybdenum, or between 30 and 40 years' supply at the highest yearly production rate. This compares with 145,000,000 tons of ore and 1,050,000,000 lb. of recoverable molybdenum as of Jan. 1, 1935. The company disclosed production rates held confidential during the war. In 1945 it produced 18,325,041 lb. of molybdenum (in concentrates), against 23,608,421 in 1944. Production for 1943 was 46,133,715 lb.; 41,852,136 in 1942; 27,751,272 in 1941; 22,778,857 in 1940; and 21,785,000 in 1939.

★United Gold Mines Co., one of the Golden Cycle group, reported that production was 82,892 tons of ore in 1945, with a gross value of $553,061, or an average of $6.67 a ton, compared with 1944 production of 67,885 tons,

with a gross value of $478,455, or $7.05 a ton. Merrill Shoup, president, reported the number of lessees increased from 8 to 14 during the year. The company controls the Portland, Vindicator, Rose Nichol, Patti Rosa, and many other properties, some of which did not operate in 1945.

★Champion Mines Co., of which Jesse Simmons, of Denver, is president, has leased the Flying Cloud property, at Cripple Creek, which is part of the Cameron Mines property, owned by Golden Cycle, and promptly ran into bad luck. Fire completely destroyed the hoist house and part of the headframe, doing damage estimated at $5,000, according to Francis Gunn, supervisor of operations. Mr. Simmons said repairs would take about a month. The Champion is using the Flying Cloud shaft for access to the Morning Star, which the Champion company owns.

★The Jerry Johnson mine, at Cripple Creek, was leased recently from the Jerry Johnson Gold Mining Co. by Andy Anderson and Hugh Connors. The mine has been closed for three years.

★Ward & Co., lessees in the Tenderfoot mine, operated by Shirley Johnson, recently ran into a pocket of rich ore on the 1,200 level. A sacked shipbent of 424 lb. settled at the Golden Cycle mill at 176 oz. of gold to the ton, and 14 oz. of silver. A one-truck shipment of 4,400 lb. ran 14.58 oz. of gold and 6.46 oz. of silver. The high grade was in the Black Diamond vein, and was mined through the Mollie Kathleen shaft.

★The Lark mine, at Silverton, continued production all winter under V. H. Steele, superintendent, and is shipping direct to the smelter. The Caledonia, another of the United Production Co. mines, and the Burrows, were closed all winter, but will resume activities this spring. Meanwhile, the Lackawanna mill has been steadily cutting down the stockpile of Caledonia ore accumulated before mill operation began. E. B. Knapp, manager of United Production Co. properties in San Juan County, including the three mines and the mill, has returned from Canada, accompanied by his son, John B. Knapp, a graduate of the Michigan School of Mines, who will be associated with his father.

★A recent flash fire at the Pittsburg mine, near Idaho Springs, in the Russell Gulch district, completely destroyed the shafthouse building and other surface structures, causing a loss of about $25,000. Men in the mine were cleared barely in time. Again this is bad luck for a new operator. The mine, closed during the war, had recently been purchased by T. F. Richards and associates, operating as the Success Gold Mining & Milling Corporation, from the Jay Gould estate. Richards says the mill, which escaped undamaged, will operate on ores from the Meeker-Success, Ivanhoe, and Barnes properties while the Pittsburg is rebuilt. A new diesel for power, a compressor, hoist machinery, a conveyor system, and ore bins were lost also.

★General Chemical Co., of New York, one of the largest users of fluorspar, has purchased the American Fluorspar Corporation's mine and mill in Brown's Canyon, near Salida, at a price reported to be $156,000. Some observers feel that this may be the beginning of a move by large users to accumulate Western fluorspar reserves, developed during the war at several places in Colorado and elsewhere for anticipated war demand. Because of the general slump in fluorspar demand, activity is now at a minimum in Colorado.

★Molybdenum Company of America's operation at Urad, near Empire, has begun a large diamond-drilling program to ascertain the shape and size of the desseminated molybdenum ore body. Meanwhile the pilot mill is running on mine ore to perfect the flotation extraction process used.

MISSOURI

Field work reveals zinc deposit in Caulfield district—Shaft is sunk at Silver Springs mine.

★Field work at the Alice mine, in Ozark County, has been completed by the U. S. Bureau of Mines. Churn drilling by the Bureau, and work by the owners of the property, have established the existence of minable sulphide zinc ore below ground-water level. This is the first time that such ore has been found in the Caulfield district.

★Production of lead and zinc from stockpiled ore recovered from old dumps is reported at Valle Mines, in Jefferson County. The property, under lease to the De Soto Mining & Milling Co., of Joplin, reportedly is equipped with a jig and table mill.

★Dolomitic limestone outcrops in central Missouri have been sampled by the Missouri Geological Survey as part of study to determine if the material is suitable for making rock wool. Similar studies also are being made of blast-furnace slags from Missouri iron deposits. The testing is being done by the Rolla Division of the U. S. Bureau of Mines.

★The Missouri Geological Survey is completing a study of the use of feldspar concentrates from southeast Missouri granite as ceramic material. A report describing the work will be published by June 1946. Mr. Leonard Larson, of the Survey, is in charge of the final phase of the work, which involves determining how to remove iron from the concentrates.

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Missouri *(continued)*

are sinking a shaft at the old Silver Springs mine, in Jefferson County. The shaft is now down about 140 ft. The ore at the Silver Springs mine contains both lead and zinc.

★The Missouri Geological Survey will soon publish a report describing the diatremes of the southeast areas of the State. These diatremes, or volcanic blowouts, are pipe-like vents in which the lava did not reach the surface. They consist of masses of brecciated limestone or sandstone cemented with a basic or ultra-basic igneous matrix. Magnetite usually is present in sufficient amounts to give good results with magnetic surveys. More than 50 of the diatremes have been mapped so far by the Survey. The diatremes are of interest because of the possibility that they are the igneous origin of the lead deposits of southeast Missouri.

ARKANSAS

Manganese ore production is resumed—Beneficiation of syenite for ceramic uses is studied

★The steel strike is over, the embargo placed on manganese shipments from the Batesville-Cushman field by the Missouri Pacific Railroad has been suspended, and all operators are back in production again. Furnaces with which the operators have contracts have opened the gate, and early in March the ore began to flow through in fair quantities. Total production in the field for February ran to 457 tons, of which 312 tons were low grade and 145 tons high grade. All the plants were in production in March.

★Because of the steel strike, the Polk-Southard Mining Co., operating the Polk-Southard property, near Cushman, R. E. Brown, in charge of operations, produced no ore in February. Its mill was in operation in March and will continue. It has purchased a new 1¼-yd. power shovel, which replaced a ⅝-yd. shovel, to increase production. The first car for shipment was loaded early in March.

★R. P. Potashnick & Co., H. E. McBride in charge of operations, produced only 50 tons in February. The company did not operate its plant in February, and the ore produced came from stripping operations. The mill was operated the first Monday in March, and will keep in steady operation. Production will run from 25 to 30 tons a day. During stripping operations in February some rich veins of high-grade manganese were discovered in the residual clay of the St. Clair and Fernvale limestones.

★Another economic use for Arkansas' abundant supply of nepheline syenite is being investigated by the geology division of the Arkansas Resources and Development Commission, in cooperation with the U. S. Bureau of Mines and the Niloak Pottery Co. Possibilities of using the rock as a source of raw material for ceramics is in an experimental stage. The Arkansas mineral has the disadvantage of having a high iron content of about 6 percent; the high-grade material obtained from Canada and North Carolina contains only about 1 percent iron. The iron must be removed from the syenite or considerably reduced before it can be used as a ceramic raw material. The Bureau of Mines is conducting experiments to reduce the iron content below the 1 percent mark required by clay products makers.

★The Baroid Sales Division of National Lead Co. has made a preliminary investigation of the Point Cedar lead and zinc mine, in Clark County. If further investigations are favorable, the company will consider operating the property.

★Leo Yount, of Glenwood, reports the discovery of another large deposit of pure-white tripoli in the Ouachita Mountains. Mr. Yount discovered a similar deposit last year and has been endeavoring to find a market for the material. The deposits are unique because they are pure white, and large reserves are available.

★E. J. Longyear Co. of Minneapolis, Minn., has recently completed a core-drilling campaign for the Big Rock Stone & Material Co. The latter company quarries nepheline syenite in the vicinity of Little Rock on a large scale for use as concrete aggregate and other building purposes.

NEW MEXICO

Silver City power rates cut—Miners and Prospectors Association to meet in Albuquerque

★The Community Public Service Co., which furnishes power and light to Silver City and adjacent mining areas of Bayard, Hanover, Central, Fierro, and Vanadium, has announced a voluntary reduction in rates, retroactive to Dec. 14, 1945, which will reduce power costs for mine operators in the area.

★The New Mexico Miners and Prospectors Association will hold its annual meeting at Albuquerque on April 19 and 20. Horace Moses, general manager of the Chino Mines Division, Kennecott Copper Corporation, Santa Rita and Hurley, is president of the association. R. H. Downer, Albuquerque, is secretary.

★About 250 C.I.O. miners went on strike on Feb. 25 at the mining properties of the American Smelting & Refining Co. at Hanover and Vanadium. The men are asking 21½c. per hour in-

crease in pay. Maintenance crews will continue to operate until the strike is settled. T. A. Snedden is in charge of the A.S.&R. properties in Hanover and Vanadium.

★A charter has been granted by the State Corporation Commission to the Southwestern Mining & Milling Co., of Albuquerque, authorizing the company to operate in the State.

TRI-STATE

Magajupa company constructs washing plant—Dines company starts sinking new shaft

★Evans-Wallower Zinc, Inc., is sinking a new shaft on the company's No. 9 lease, south of Picher, according to Floyd W. Gooch, of Joplin, general manager. The shaft is in the northeast corner of the 160-acre tract of the Cardin 200-acre lease held by the company. Sinking of the shaft, which has been designated as the No. 16, has been contracted to Reynolds & Soulen. Churn drilling in the immediate area several years ago showed an upper run of ore, and the present shaft is being sunk to a depth of about 160 ft. on the basis of that exploration work, Gooch said. When the development work is completed, ore will be trucked to the company's No. 4 mill, which is re-treating tailings on the company's No. 4 lease.

★Dines Mining Co. has started the sinking of a new shaft on the Stoskopf land, which adjoins on the west the Hartley mine, operated by the company on the West Twelfth St. road out of Baxter Springs. The new shaft will be put down to a depth of 300 ft. to expand the company's sheet-ground operations in the area, according to H. G. Weidman, of Baxter Springs, manager. The 400-ton hopper and derrick at the company's Douthat mine, on the DeVillers land, a mile south of Cardin, will be used at the development, Weidman said. A sinking derrick was erected over the shaft site, and the other units will be built as the shaft is deepened. The 10-acre Stoskopf tract lies between the Hartley on the east and the Youse-Slaughter 10-acre strip to the west, and is south of the old Federal Homestake mine. Eagle-Picher Mining & Smelting Co. is mining the Youse-Slaughter tract from the Leopard lease to the west. Ore from the new mine will be trucked to the company's Blue Mound mill, north of Picher, in Kansas.

★W. O. York, of Baxter Springs, and associates are conducting stripping operations on the Swartz land, east of Lone Elm on the north side of Turkey Creek. The shallow zinc ore deposits in the creek bottoms along the right bank are being worked by means of draglines and power shovels. Ore from

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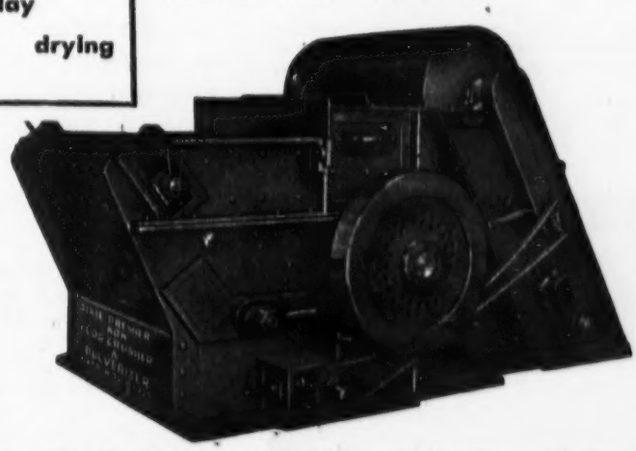

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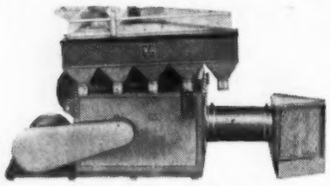

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Tri-State *(continued)*

the operations is being treated at the nearby Swartz mill.

★West & Co. have reopened the old Napoleon mine, in the southeastern part of the Thoms Station mining area. Operations are being carried on around the 170-ft. level, with a reported recovery of 10 percent in blende values. The ore is being treated over the Thoms Station custom mill of the St. Louis Mining & Milling Co. The mine was unwatered by the installation of two turbine pumps, an 8-in. Fairbanks-Morse in the No. 1 shaft and a 6-in. Pomona in the No. 2 shaft. Mine operations are being carried on at the latter shaft under the direction of Luther Owen, of Joplin, who is in charge of development work.

★In a memorandum opinion on the merits, filed in the District Court of the United States at Joplin, Mo., in February, District Judge Albert L. Reeves found for the defendants in a suit for recission of a contract to transfer an invention, brought by Charles L. Tebbard against the American Zinc, Lead & Smelting Co. and Minerals Beneficiation, Inc.

The case involved the use of an improvement in the Wuensch process known as an air lift in the treatment of lead and zinc ores. Judge Reeves held that the defendant companies had fulfilled their obligation to Hebbard, formerly a draftsman and engineer who worked for MBI, and that Hebbard was not entitled to recover anything. Hebbard brought suit to rescind a contract whereby his former employers produced the device in question, and he also sought an accounting and a settlement which, had he won, would have involved a large amount of money. The process is now used widely.

MICHIGAN

Calumet & Hecla opens new ground in Keweenaw—Underground employment rolls show increase

★Though mine production has decreased because of exhaustion of deposits, search for new orebodies continues in the Michigan copper district. In recent years, Keweenaw County has been the scene of extensive exploratory work by Calumet & Hecla. Diamond drilling is still proceeding in unexplored areas in the hope of opening commercial ground.

One of these projects is near Copper Harbor, where Calumet & Hecla a few years ago acquired extensive mineral lands owned for many years by the Estevant estate, of Paris. Another deal involving a large acreage was the purchase by Calumet & Hecla of the Keweenaw Copper Co. It is expected that a thorough program of diamond drilling will be undertaken in this tract.

The company is opening virgin ground in Keweenaw through two new shafts, the Iroquois, near Seneca Lake, and the other just north of the old Allouez mine. Interesting discoveries have been made in the latter area, and development work indicates that values are continuing on the strike as well as the dip of the lode.

Mining operations are under way in Centennial and Kearsarge and a considerable tonnage is coming from both departments to supplement the Ahmeek mine production. It is believed that the Kearsarge amygdaloid, the master vein of the district and long a prolific producer, has many more years of life for Calumet & Hecla.

The company's entry into the secondary copper field, to compensate so far as possible for the loss of production from the Calumet sands, has been successful. Another phase of operations is the production of copper chemicals in the leaching plants at Lake Linden and Tamarack mills.

The company's fabricating plant, the Wolverine Tube Co. Detroit, insures a continuous market for refined copper

The number of men in the underground department of Calumet & Hecla increased in February, and mine production should become greater as soon as the new men are sufficiently trained in their work. The larger number of men hired is due to the cooperation between Calumet & Hecla and the United States Employment Service in the latter's efforts to provide jobs for all workers in the area. Returning servicemen accounted for part of the increase, with men from the south end of the district and some from the industrial centers making up the remainder.

Sinking is under way in No. 4 Kearsarge shaft, which will be lowered an additional 380 ft. to the 35th level of No. 1 Kearsarge. Stoping ground is being opened in No. 3 Kearsarge territory from the 30th level of No. 4.

Shortage of drill steel and bits is being felt in the operations of Calumet & Hecla. Every effort is being made to conserve these important items to avoid work interruptions.

IRON COUNTRY

Great Northern trust reports earnings—North Wade open-pit mine to start production

★Great Northern Iron Ore Properties passed the $100,000,000 mark in 1945 in its distributions to holders of certificates of beneficial interest in the Trust, the total being $101,625,000. equivalent to $67.76 per share. The Trust was created Dec. 7, 1906, with Louis W. Hill, James N. Hill, Walter J. Hill, and Edward T. Nichols as trustees. It was divided in 1,500,000 shares of beneficial interest, which were

distributed, share for share, to the shareholders of Great Northern Railway Co. as a dividend. On Jan. 23, 1945, Louis W. Hill, who has been president of the trustees since the inception of the Trust in 1906, resigned and was succeeded by Philip L. Ray. The Trust's iron-ore properties are all on the Mesabi Range. Of the total tonnage of iron ore shipped from the range to recent date, exceeding 1,437 million gross tons, 291 millions came from the Trust's mines. These are 33 in number, of which 19 were producers in 1945.

★The North Wade open-pit iron ore mine near Kinney, Minn., on the Mesabi Range, will be brought into production this season as a joint operation by Inland Steel Co. and Cleveland-Cliffs Iron Co., according to an announcement recently by R. L. Wahl, general superintendent of Inland's iron-ore properties. Orders have been placed for shovels, trucks, and other equipment, and stripping will start as soon as these have been delivered. A substantial tonnage of ore will be shipped this season. The North Wade was acquired by Inland late in 1945 and will be operated by Cleveland-Cliffs Iron Co. under terms of an agreement reached with Inland. Inland's present operating iron-ore properties consist of four underground mines in Michigan and Minnesota.

★Only three mining firms have signed with the unions on the Mesabi, Cuyuna, and Vermilion iron-ore ranges of Minnesota. Indications are that the strike will continue in most of the independent mines. To date contracts have been signed with the Oliver Iron Mining Co., The Interstate Iron Co., and the Wheeling Steel Co. All of these contracts provide for the 18½c. per hour increase.

ALASKA

U. S. Smelting company reports new wage scale — Alcoa buys limestone deposits to treat laterite

★Roy B. Earling, general manager of U. S. Smelting, Mining & Refining Co.'s operations at Fairbanks, has reported the adoption of a new wage scale, effective March 1, in the Fairbanks and Nome areas. Ditch walkers, dredgeshoremen, and laborers at the creeks get a base rate of $1 per hour. Board rate was increased to 75c per meal. He also stated that in March there were 75 men on the payroll at Fairbanks doing thaw drilling and repair work on dredges, and that the company planned to increase that number as quickly as competent men could be obtained, but that preference was being given to the old employees coming out of the service. "We expect we will need several hundred new men to bring our Fairbanks payroll up to

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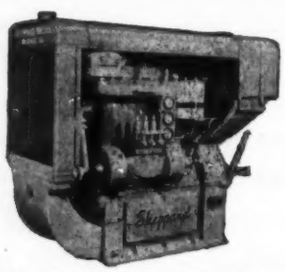

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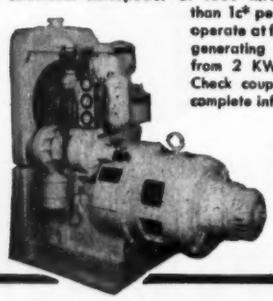

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Alaska *(continued)*

the 850 we employ at peak season. The same undoubtedly will apply to Nome," Mr. Earling stated in Seattle.

★Santiago Mines, Ltd., represented by Lester Gore, in Ketchikan, plans to install a 50-ton mill at its Lucky Nell mine, and to drift 600 ft. this spring. A 7-mile road is being completed at the property.

★Bonanza Mining Co., a new corporation capitalized at $3,000,000, is taking over the old Silverado mine and ground adjoining the Prosperity and Porter-Idaho mines. The company plans to start prospecting with diamond drills and to resume development in the old Silverado.

★Casa de Paga Mining Co. had a crew of men come into Nome from Seattle the early part of March, and under direction of Donald Stewart, manager, planned to move its dredge six miles from Beaver Creek to Bajara Creek.

★Yukon Corporation, of Fairbanks, which has acquired an $80,000 dredge at Fox Bar, on the Kougarok, 100 miles from Nome, has 21 other properties, nine of which are lode and the others placer, and expects to bring several into production this year, according to C. A. Sherman, chief engineer. Most of the company's operations are gold, but it will also produce platinum 150 miles south of Fairbanks, and tin near Teller. According to C. A. Sherman, the company is shipping $15,000 worth of equipment this season to the Miller placer ground, 150 miles south of Fairbanks, which contains platinum and gold. A 2½-ft. Sauerman bucket which can handle 1,500 cu.yd. per day will be installed. The company has also taken over the Standard mines, at the foot of Mt. Hayes, which Sherman estimates to contain 2,000,000 cu.yd. of gravel running 57c. a yard.

★Devault and Associates have bought the hydraulic-placer operations of Johnny Olsen on the Seventymile above the falls. They plan to use mechanized quipment this season. Several miles of ground below the falls is owned by Leslie Chester.

★The former hydraulic operations on Napoleon Creek, a tributary of the Fortymile below Walkers Fork, is to be worked by mechanized equipment this season by Al Stout, Al Lindstrom and Fred Tullewigger. Twenty tons of freight is being hauled by tractor from Tok Junction to the property.

★The Alcoa Mining Co., a subsidiary of the Aluminum Company of America has purchased limestone deposits on Kosciusko Island, off Ketchikan, Alaska. The lime will be used to treat laterite deposits containing high alumina which, according to a recent company announcement have been discovered in Oregon.

★The North American Dredging Co., Alex Mathison owner, will operate in the Flat-Ophir district again this season. This is the only dredge in this area that operated during the war.

★High Matheson will resume dragline operations on Spruce Creek near Ophir for the first time since 1942. Degnan and Rosander will resume tractor dragline operations on Little Creek. Nels Vibe who operated his dozer-dragline plant on Little Creek with a two-man crew last year expects to employ a full crew this year. The Pontella dredge and the Hard and Uotilla mechanized operations are also planning to operate.

CANADA

Access roads planned for Red Lake and Lake Chibougamau areas—Yukon activities increase

★The stability of wages in the Canadian mining industry is shown by the Dominion Bureau of Statistics at an average of 85.9c an hour for the first week of January 1946, compared with 85.3c for the same period a year ago. In British Columbia, wages for mining metallic ores average 90.9c on Jan. 1, 1946; in Ontario, 86c; in Quebec, 78.7c. Metal mining in Canada employed 28,863 wage earners on Jan. 1, 1946; non-metallic minerals (except coal), 8,214.

★Debate on the first and second readings of the Hollinger Bill by the Provincial Legislature in Quebec raised "grave doubts as to the advantages to Quebec" concerning the proposed exploitation of iron-ore deposits by Canadian and United States capital. The bill provides for an exploration license covering 3,900 square miles of the total of 319,000 square miles comprising the undeveloped and largely unexplored New Quebec territory north to Ungava Bay and Hudson Strait. The Hon. Jonathan Robinson, Minister of Mines, referred to the area of the concession to Hollinger North Shore Exploration Co. as "just a spot in relation to the whole. Honest capital should be made welcome in this Province." The company is required to pay the Province $10,000 on issue of the license and $6,000 a year until 1952, when the license is renewable for two consecutive five-year periods. Hollinger is required to spend $25,000 in 1946 for exploration and $39,000 annually to the end of the license period. Surrounding the concession for the first ten years is a strip of country 10 miles wide where no prospecting is to be permitted. The company is guaranteed exclusive possession for 80 years after exploration work is completed on payment of $100,000 a year to Quebec, plus the established mine tax and rental, for the life of the lease.

★Announcements have been made in Ontario and Quebec of plans for building this year two roads, each of about

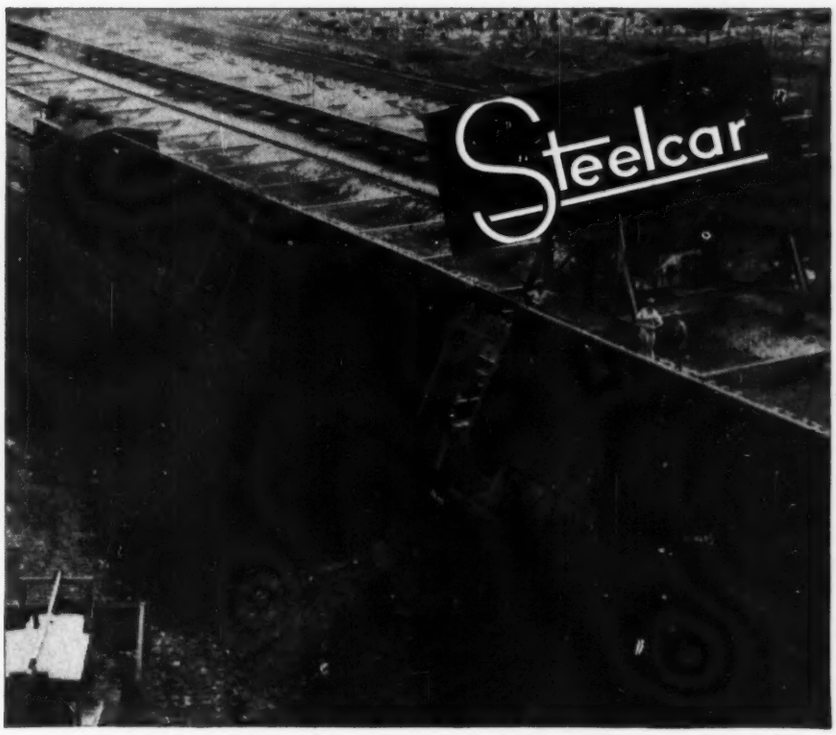
100 miles, to make accessible mining areas of major importance. One is in northwestern Ontario, from Quibell, on the railroad, to Red Lake; the other will connect Lake Chibougamau, in Quebec, with the railroad at Lake St. John. The Red Lake camp has been active for 20 years, has five producing mines, and a number of properties in the advanced stage of development. The Ontario Hydro Commission has announced that the Red Lake transmission line will be completed by June to the Campbell and Dickenson mines. Chibougamau has four properties with commercial ore proved or indicated, and the Opemiska mine, which is within 20 miles to the west. A. O. Dufresne, Quebec Deputy Minister of Mines, has announced that a 20-mile mine road is also to be built north of the railroad to Ligneris Township, where an important discovery was made last summer on the property held by Dome Mines.

ONTARIO

★Aunor Gold Mines, one of Canada's first gold producers to regain capacity production, reported a return to the full milling rate of 475 tons a day in March for the first time since 1942. The rate is to be expanded to 500 tons in the near future. The mine manager, Stanley S. Saxton, reported the discovery of a new oreshoot on the 1,875-ft. level averaging $9.24 a ton for the length of 200 ft. This shoot lies outside the main ore zone, which, on the 1,625 level, was reported to have an uncut average of 3 oz. for a length of 456 ft. The main shaft is down to 2,160 ft.

★Steady improvement in the scale of mining has been reported by Macassa Mines, Kirkland Lake, where 238 tons a day were treated in February. Gradual expansion is expected to reach 300 tons in June. Average gold recovery for the mine, 1933 through 1944, was reported at $16.75 a ton. At the end of 1945, 60 percent of the ore reserves were accounted for in branch veins in the hanging wall. With the new winze completed to a depth of 4,750 ft., development is being started to open a 500-ft. block of new ground. The major source of ore at Macassa has been the syenite forming the hanging wall along the main fault zone, from which the narrow branch veins dip south. The branch veins are high grade. G. A. Howes is mine manager.

★Preparations to resume mining operations have been reported by Undersill Mining Co., controlled by the Newmont subsidiary, Northern Empire Mines. The shaft has been unwatered on the Undersill property (formerly Sand River Gold Mines) and is to be deepened to 2,600 ft. The property is equipped with a 100-ton mill, and ore reserves on two levels below the 1,150-ft. horizon are reported at 48,931 tons averaging $14.17 a ton (gold at $38.50 per ounce). Underlying the old workings is a 570-ft. sill of diabase. From



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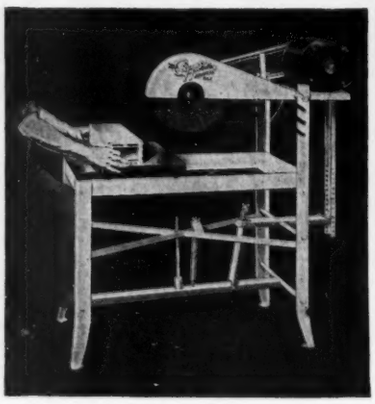

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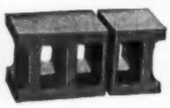

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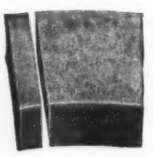

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A 300-FT. BELT TRANSFERS ORE from an underground crusher to shaft loading pocket at the Lake Shore mine, Kirkland Lake, Ontario, where preparations are being made to sink an internal shaft from 6,825 ft. to 8,000 ft. This will be the deepest shaft in Canada. The method of lagging, the back of the tunnel with wire netting, shown in the halftone, suggests a good use for old hoisting rope. Wide World photo.

Canada (*Continued*)

1937 through August 1942, the mill produced $1,876,196. Fred Searls, Jr., of New York, is president.

★On the property of Preston East Dome Mines crosscuts are being advanced north on five new levels to the porphyry orebody. After deepening the shaft to 2,388 ft. a program was started to explore porphyry to the northeast and to the west. The main source of ore has been in the north section, but promising possibilities were also indicated by diamond-drill holes in the west formation, adjoinig the Cincinnati Porcupine property. G. G. Campbell is mine manager.

QUEBEC

★Elmac Malartic Mines, situated in Dubuisson Township, four miles east of Malartic Gold Fields, has been securing important ore intersections from diamond drills working both on surface and underground, guided by results of a geophysical survey. At a distance of 700 ft. northwest of the shaft a 40-ft. width was intersected averaging $7.58 a ton based on gold at $38.50 per oz. The main vein zone across a 22.5-ft. width disclosed a value of $23.80 per ton in drilling below the second level at a 350-ft. depth. A. G. Darling, mine manager, reported that 50 ft. below this latter intersection, and 115 ft. under the bottom of the winze, a drill hole intersected 11 ft. averaging $20.16 per ton.

★New Bidlamaque Gold Mines, Bourlamaque Township, in January started sinking a 390-ft. shaft. Lateral work is to be done on three levels, amounting to 2,000 ft., as a preliminary objective. Construction of the necessary buildings has been completed. An intensive drilling program under the supervision of Hal S. Wilson, consulting geologist, traced the main ore zone and showed a width of 300 to 400 ft. in the hanging wall to the north, where narrow, high-grade veins occur. The drilling has indicated a copper content averaging 1.4 percent copper in addition to the gold. Underground exploration is to be directed to a large body of quartz west of the main vein zone, where 37.3 ft. of core from one drill hole averaged 2.24 percent copper and $1.07 per ton gold.

★Shaft sinking has been announced by East Amphi Gold Mines as part of a program of underground exploration to be conducted under the management of Howey Gold Mines. The cost is estimated at $250,000. A three-compartment vertical shaft is being put down on contract south of the drilled zone on the east group of claims. A portable diesel plant has been installed. The shaft will be sunk to 500 ft. and levels established at 300 and 450 ft. The contract includes 5,000 ft. of lateral work and 10,000 ft. of underground diamond drilling. T. W. MacDowell is vice president of East Amphi.

MANITOBA

★Sherritt Gordon Mines, Ltd., during 1945 milled 646,092 tons of ore, a daily average of 2,544. The west mine contributed 363,350 tons and 282,742 tons were drawn from the east mine. During the fourth quarter the labor situation again became satisfactory. In the west mine development work was continued on the ninth and tenth levels as labor was available. The major part of the ore was extracted from between the sixth and eighth levels. In the east mine two small offshoot

bodies were developed, one in the zinc section and the other in the copper section of the east orebody.

Eldon L. Brown, president and managing director of the company, has released the following drilling results on the Lynn Lake property, in the Granville Lake area. Hole No. 10 encountered hornblendite, with very little mineralization. Hole No. 12, drilled 400 ft. west, gave the following results:

Footage	Nickel, Percent	Copper, Percent
168.0 = 171.6	1.0	Nil
332.0 = 342.0	0.61	0.73
360.0 = 362.0	2.23	Nil

Hole No. 14, drilled 50 ft. west of No. 12, was as follows:

Footage	Nickel, Percent	Copper, Percent
85.0 = 200.0	0.53	0.55
230.0 = 265.0	0.49	0.31
382.4 = 426.8	1.23	0.64

These holes are 4,500 ft. south of the initial work done on the property. It is proposed to concentrate all drilling on the ice on Lynn Lake until break-up.

★Howe Sound Exploration Co., Ltd., expects construction of the 48-mile power line from Sherridon to the property at Snow Lake will be completed shortly. Freight has been moving over the winter road crossing Herb Lake at an average rate of 50 tons daily. Preliminary excavations for mine plant buildings has started and construction of the 35 mile road to the mine site has begun. Contract for the headframe has been let. The design of the 2,000-ton mill is being done by General Engineering Co. of Toronto, under the direction of H. A. Pearse, consulting metallurgist for Howe Sound Co.

★Camwe Snow Lake Mines, Ltd., reports that diamond drilling has been started on its property adjoining that of Howe Sound Exploration Co., Ltd., at Snow Lake. The work is being done under the direction of Pioneer Gold Mines for American Smelting and Refining Co. An attempt will be made to locate a western extension of the fault zone on the Howe Sound property.

★The company referred to as the Manitoba Central Mines, Ltd., in the March Regional News, will be incorporated under the name of Greater Manitoba Gold Mines, Ltd.

BRITISH COLUMBIA

★Dr. H. T. James, managing director of Pioneer Gold Mines of B. C., Ltd., has been reelected president of the Mining Association of B. C. for 1946. Vice presidents are A. S. Baillie, vice president and general manager of Granby Consolidated Mining, Smelting & Power Co., Ltd., and H. P. Wilson, president of Crow's Nest Pass Coal Co., Ltd. The executive committee consists of C. P. Browning, Dr. W. B. Burnett, H. L. Batten, V. J. Creeden, F. W. Guernsey, M. M. O'Brien, and R. H. Stewart.

★A firm commitment has been received by Surf Inlet Consolidated Gold Mines, Ltd., for the remaining 315,145 treas-

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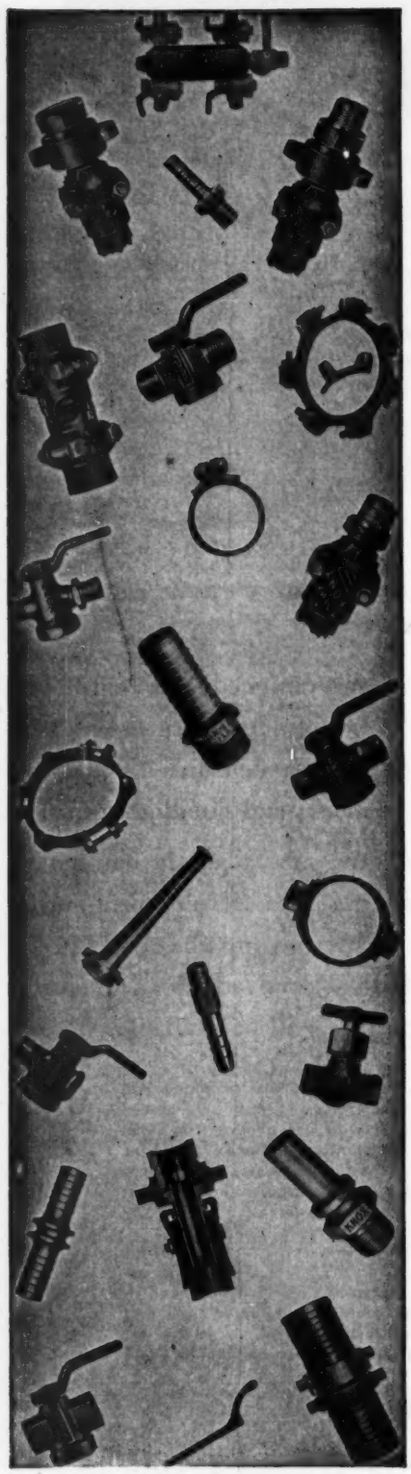

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Canada *(continued)*

ury shares at a price of 50c. per share, thus assuring working capital of more than $350,000. William H. Hax, managing director, has advised Vancouver associates that a fund of two million dollars will be available if required for exploration and development.

★The annual meetings of Reno Gold Mines, Ltd., and Central Zeballos Gold Mines, Ltd., in which Reno holds a 40 percent interest, were advised that development was again in progress at the Central Zeballos mine, Alberni mining division, and that production would start within three months.

★Bulk samples of ore from the Vancouver Island property of Cangold Mining & Exploration Co., Ltd., after extensive tests by the Denver Equipment Co., have yielded recovery of 93.22 percent by amalgamation and concentration. The samples gave average assays of 0.665 oz. gold and 2.01 oz. silver per ton. The Cangold property is scheduled to start production in September.

★The Vancouver Island property of Twin "J" Mines, Ltd., will return to production within 90 days, according to an announcement by the management. Ore reserves were estimated by Carl Erickson in 1942, prior to the brief operation on behalf of Wartime Metals Corporation, at 120,000 tons, averaging 0.14 oz. gold, 3.9 oz. silver, 1.9 percent copper, and 8.07 percent zinc. Only 34,893 tons were mined. Concurrently with mining and milling a diamond-drilling program will be initiated to probe the Richard III property, idle since 1904, when the report of the Minister of Mines stated the sill of the lowermost level was in ore of good grade in gold. Arrangements are being made for the marketing of a composite concentrate. The property is equipped with a 150-ton mill and complete mining plant.

★Pioneer Gold Mines of B. C., Ltd., has cut a vein 5 ft. wide in the Taylor crosscut at an elevation of 200 ft. above the Pioneer shaft and 100 ft. above the highest Bralorne level. Assays vary from 0.2 to 1.8 oz. and grade 0.6 oz. gold per ton. The strike of the vein diverges about 20 deg. from the projected extension of Bralorne's "51" lead into Pioneer ground. The driving of the crosscut will be suspended temporarily while drifting is done on the vein. Little is known at present of the characteristics of the lead, but it appears likely it could be reached at a vertical depth of approximately 600 ft. by extension of present workings on the fifth level for about 750 ft.

★Col. J. A. Maller, of London, England, and associates plan to expend $200,000 during 1946 for development of extensive placer leases on Lightning Creek, Cariboo mining division. About 50 men will be employed and special equipment will be used for shallow testing.

★A public offering of 400,000 shares of North American Goldfields, Ltd., at 25c. per share has been oversubscribed. The company has issued 600,000 shares for properties, equipment, and other consideration and retains 1,000,000 unissued shares in the treasury. Directors include Glenville A. Collins, Vancouver, and Frank O. Morris and Norman W. Whittaker, Victoria. One dredge is ready to operate on the Quesnel River and a second will be put in service during the summer.

★Diamond drilling is proceeding on a two-shift basis at the Greenwood district properties of Brooklyn-Stemwinder Gold Mines, Ltd. The shaft is being dewatered and drifting will be undertaken at depth to check intersections already obtained. Geophysical exploration will start soon, under the direction of Dr. Victor Dolmage, consulting geologist. Dr. H. Kamins, Detroit, Mich., has been added to the board of directors.

★Production is anticipated at the Nelson district properties of Kenville Gold Mines, Ltd., subsidiary of Quebec Gold Mining Corporation and Noranda Mines, Ltd., during 1946, following extensive diamond drilling and tunneling last year. The group embraces the Granite-Poorman, Athabasca, and several other properties near Nelson.

★Bayonne Consolidated Mines, Ltd., is expected to resume milling early in April. Favorable development on both the Main and "A" veins is reported. A shaft has been sunk to establish a new level 100 ft. below the 800-ft. horizon and lateral development is now in progress.

★Following reclamation of the No. 6 main-haulage level of the Bosun mine, Slocan mining division, Santiago Mines, Ltd., is now preparing stopes for mining of high-grade silver-lead ores for shipment to the Trail smelter. A shipment of machinery and equipment, including complete mining plant, has reached the property.

★Fern Gold Mines, Ltd., has been incorporated to take over properties in the Nelson mining division under development jointly by Premier Border Gold Mining Co., Ltd., Quatsino Copper-Gold Mines, Ltd., and Harold Lakes, Nelson mining engineer. In view of the favorable results in drifting on the Fern vein beyond the fault, the two financing companies will continue to furnish funds for development.

★The regular quarterly dividend of Bralorne Mines, Ltd., of 20c. per share, will be paid April 15 to shareholders of record March 23.

★Rusdon Gold Mines, Ltd., a new B. C. Incorporation, has acquired title to all properties in the Lillooet mining division, formerly owned by Grange Consolidated Gold Mines, Ltd. A reported company announcement states $50,000 will be spent on development. A con-

tract for diamond drilling to a cost of $15,000 has already been let.

★Hedley Yuniman Gold Fields, Ltd., has encountered two closely parallel veins carrying commercial values in gold. The veins were discovered in a crosscut driven to investigate at depth veins indicated by surface exposures. The new leads are not believed to be those sought.

★February production of The Cariboo Gold Quartz Mining Co., Ltd., was 2,040 oz. gold, valued at $78,540, from 5,941 tons of ore milled. Despite repeated offers of Eastern capital of funds "for financing more rapid development," the company has refused to increase its issue of capital stock, according to an announcement by Dr. W. B. Burnett, president.

★February production of Island Mountain Mines, Co., Ltd., Newmont subsidiary, was 1,269 oz. gold, valued at $48,851, from 2,747 tons, averaging 0.462 oz. gold per ton.

★Shareholders of Cariboo-Hudson Gold Mines, Ltd., have agreed to surrender four shares of their present stock for one share in Cariboo Hudson Gold Mines (1946), Ltd., in which new finance has invested $35,000 for 350,000 shares and acquired options to place a further $215,000 in the treasury. Fresh development will be undertaken at once.

YUKON TERRITORY

★Sunshine Mining Co. of Kellogg, Idaho, will work ground on Glacier and Big Gold creeks, in the Dawson area, under the name of Sunshine Mining Co., Yukon Division. Work during 1946 will be entirely preparatory and in 1947 thawing will be done. A 3½-cu.ft. bucket-line dredge, stored at Dawson, will be in operation in 1948.

★Keno Hill Mining Co., Ltd., Frank Buckles in charge, will soon start exploration in the silver-lead mines formerly operated by Treadwell-Yukon Corporation in the Mayo district.

★E. N. Patty, general manager of McRae-Patty Co., reports that his company has made contracts with the Walter W. Johnson Co., of San Francisco, for two modern dredges of all-steel structure, with pontoon hulls, to be placed on Henderson Creek, 80 miles above Dawson, and on Thistle Creek, about 125 miles above Dawson, well-known old-time placer districts in the Upper Yukon. The company already has three dredges working in the Yukon River area. The new dredges will have 4½-cu.ft. buckets, each capable of moving 3,000 to 3,500 cu.yd. per day, and will be diesel-electric driven. They will be delivered in the Yukon this season and will be hauled in next winter in time to start operations in 1947. This summer, camps will be prepared and thawing will be done. E. F. Wann will be in charge of operations of the company's two dredges on Coal Creek and Woodchopper Creek, above Circle, and a third dredge will be operating on Clear Creek, east of Dawson.

★George E. Murray of Stockton, Calif., is operating under an option on the gold placer property on Iron Creek, in the Alsek district, owned by B. Beloud, of Whitehorse. Ed Barker and Irving Ray have several miles of placer ground on Shortly Creek, in the same district. Work which they started in 1945 will be continued this summer with seven men and a highlift shovel.

★W. H. S. McFarland, general manager of Yukon Consolidated Gold Corporation, Ltd., expects production in 1946 will be more than $1,500,000 and that the company will reach full production in 1947. With final reports, it is anticipated that production in 1945 will be more than 50 percent higher than it was in 1944. Dredging operations this season are expected to be as follows: Dredge No. 8 on Middle Sulphur Creek; No. 10 at Middle Dominion Creek; No. 11 at Middle Hunker Creek; No. 3 on Lower Klondike River; No. 4 on Bonanza Creek; No. 7 on Quartz Creek, and No. 8 on Lower Sulphur Creek, if that ground can be prepared.

★G. A. Jeckell, controller of the Yukon Territory, reports 670 miles of placer leases were granted in the year ended September, 1945.

★Renewed interest in mining in the region is evident from the report of the British Columbia and Yukon Chamber of Mines that 165 have registered at its 28th annual mining school. The number is made up chiefly of men released from the service and from war industries.

MEXICO

Mine strikes are settled—Copper and zinc production decreases 20 percent

★Depressed conditions of the mercury market were cited as reasons for suspending works by Oro, Plata y Mercurio, S.A. and Beneficiadora de Mercurio, S.A., Nuevo Mercurio, Zacatecas. The employees complained to the Labor Ministry that the companies stopped work without warning them. Juan Jimenez, manager for both companies, told the Ministry that difficulties in obtaining explosives and combustibles, plus bad market conditions, have made operations unprofitable.

★Mining in Mexico has been relieved, for at least two years of labor troubles, with the settlement on March 7, of the strike against 28 of the 32 silver companies and five treatment plants that began on Dec. 31 to enforce demands for a 40 percent pay increase. Labor gained an average raise of 25 percent, plus economic benefits that cost the companies about 2,000,000 pesos ($415,-

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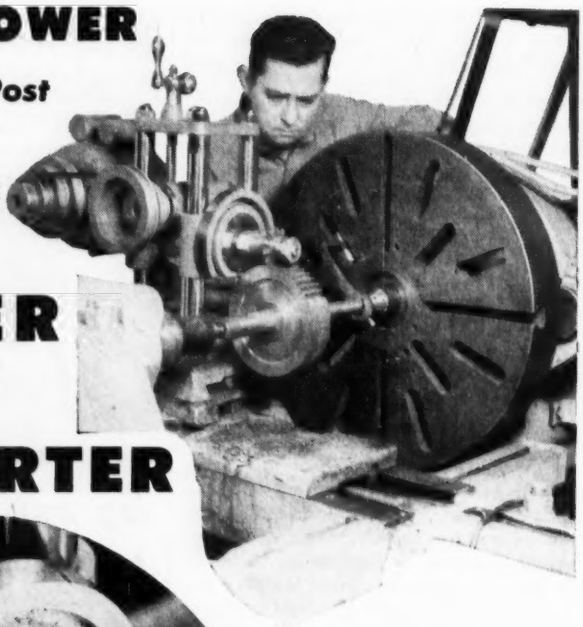

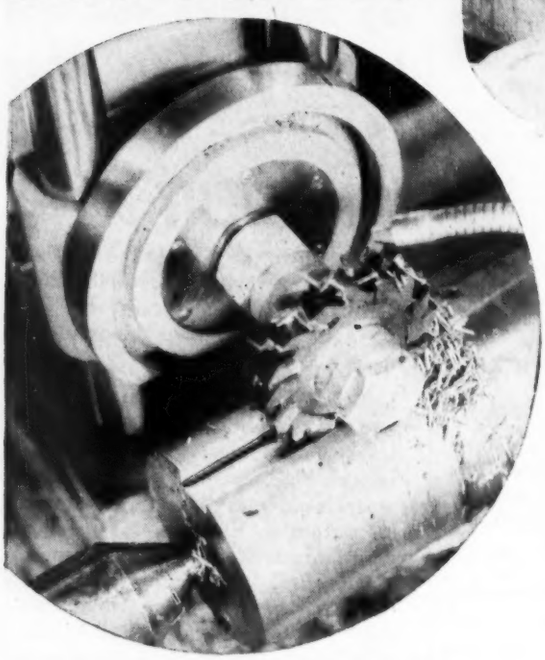

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Mexico (*Continued*)

000) a year, large lump sums as costs of the strike, and payment of wages amounting to 50 to 100 percent, during the strike.

★Mexico City mining circles estimate that copper and zinc production has dropped about 20 percent as a result of the ending of contracts with Metals Reserve. These sources say the higher price of Mexican silver in the U. S. has not counterbalanced losses from decreased copper and zinc production, because most of the added profits from exporting silver are absorbed by taxes and labor costs.

★Complaint was made to the Labor Ministry by Cananaea Consolidated Copper, Cananaea, Sonora, that its production was seriously affected by a series of daily strikes of an hour by its miners and plant workers. The employees said the strikes were a protest against moves they averred the company is making to pare working personnel because of cancellation by Metals Reserve contracts and dubious prospects of export sales to offset that loss.

★Gold, silver, and lead deposits in the Jocotitlan region, Guerrero, are to be exploited by Pamasco, S.A., newly organized subsidiary of Pan American Mining & Smelting Co., of which D. Sylvanus Williams is president and general manager. In addition to leasing five mines owned by the Cia. Minera Orotepec, S.A. Pamasco plans to establish a mill at the Jocotitlan properties.

★The second national conference on tuberculosis and silicosis will be held in Mexico City, July 21 to 27, by the Mexican Society for Studies about Tuberculosis. American delegates have been invited. Dr. Fernando Rebora, president of the society, is chairman of the convention's executive committee, and Dr. Frederick Rohde, chief physician of the mines department of American Smelting & Refining is its vice chairman.

★The Mines and Petroleum Department of the Ministry National Economy announces it is examining 451 applications for mining concessions. The requested franchises are for properties said to have good showings of gold, silver, manganese, antimony, tin, lead, and mica in Aguascalientes, Coahuila, Chihuahua, Durango, Guanajuato, Guerrero, Hidalgo, Jalisco, Michoacan, the State of Mexico, Nayarit, Nuevo Leon, Oaxaca, Puebla, Queretaro, San Luis Potosi, Sinaloa, Sonora, and Zacatecas.

★Silver coin production by Mexico's lone mint in Mexico City is suspended, pending clarification of the matter of whether or not the U. S. will again raise the price of imported silver. A higher price in the U. S. would entail new calculations regarding the silver content of Mexican coins. The mint is continuing its production of copper and copper-nickle coins, all of small denominations.

VENEZUELA

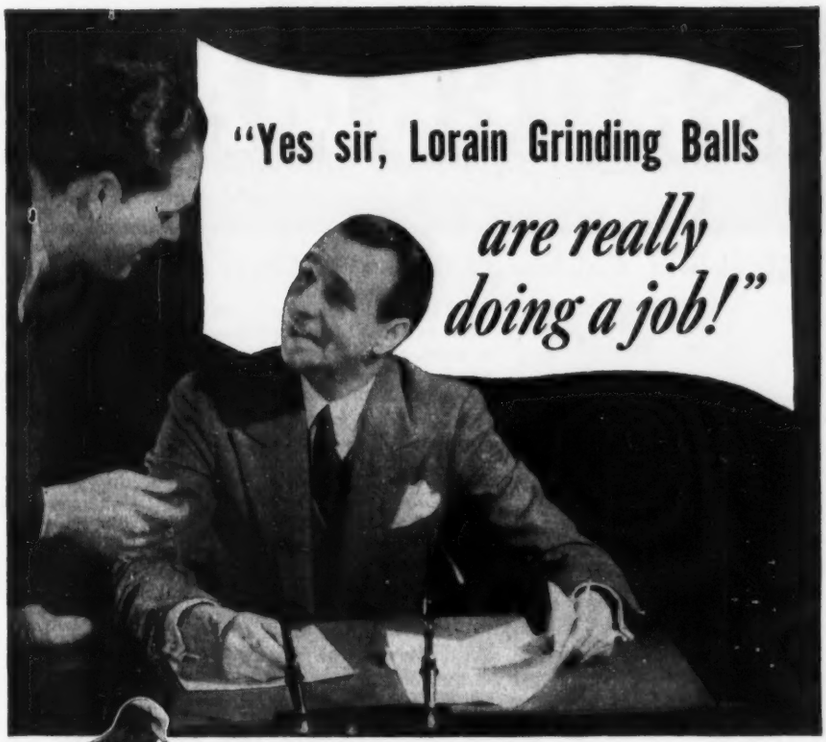
New Government aids mining industry—U. S. companies develop and explore iron properties

★The review for the second half of 1945 must include reference to the sudden change of government in October. A revolt, led by young officers of the Venezuelan land, sea, and air forces, was successful in overthrowing the government of General Isaias Medina, whose term of office was due to expire in April, 1946. The change was accomplished with comparatively little bloodshed, and most of the three days' fighting took place in the center of Caracas, the capital. Free elections are scheduled for April, and in the meantime a "Junta Revolucionaria," composed of seven persons, of whom five are civilians and two army officers, is responsible for the government.

The party supporting the armed forces is "Accion Democratica," led by the famous author, Romulo Gallegos. The president of the revolutionary committee is a Venezuelan economist, Sr. Romulo Betancourt.

The first acts of the new provisional government were to dismiss a number of corrupt government officials and to initiate a campaign to lower the cost of living. It has also promised to respect existing contracts and to welcome foreign capitalists wishing to establish new industries. The new government soon gained recognition by foreign countries, and so far there has been no sign that there will be any deviation from the principles and program outlined in speeches by members of the junta.

★The position of the major Venezuelan producer, the New Goldfields of Venezuela, Ltd., became steadily worse during 1945, owing to the serious condition of the power plant, which has been working at low efficiency for several months. This has been due to lack of spares, which were not available during the war, for the English-made National gas engines. Operations were being carried on at a loss and reached a point where the company's local resources were exhausted and the Venezuelan government was appealed to for assistance. Following an exhaustive report by the government's consulting engineer, a loan of Bs500,000 ($150,000) was made, and this should cover all operating losses until such time as the power plant has been repaired and thoroughly overhauled. The number of men now employed totals 908 and the monthly output has been reduced to about 7,000 tons of ore. Development work done during the past fiscal year was small but was an improvement on that of the previous fiscal year. In the Laguna mine high-grade ore was encountered on Level 4 West and in winzes sunk



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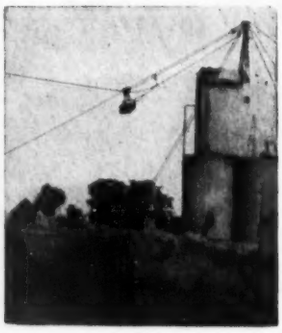
Slackline Cableway Is in a Class by Itself



Cableway Feeds Screening Plant from Deep Pit

Above picture shows a Sauerman Slackline Cableway mining a gravel deposit 90 ft. deep and 1,000 ft. wide and moving the material to a hopper on top of screening plant at rate of 110 tons an hour. Operating cost is only a few cents a ton and machine handles all material within its radius.

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Venezuela *(continued)*

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Venezuela *(continued)*

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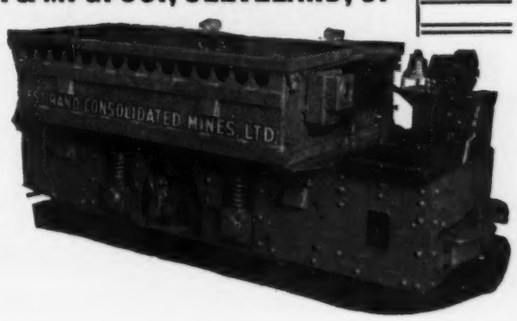

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Venezuela *(continued)*

ranged to carry out exploratory work on the Imataca Range.

★The International Nickel Co.'s engineers have completed the sampling campaign in the Lomo de Hierro region and are preparing to examine a large area under option in the vicinity of the town of Tinaquillo, State of Cojedes. The field staff has been increased by two geologists, who are doing reconnaissance work and mapping.

Some 900 tons of garnierite ore have been shipped to the U. S., for treatment in a pilot plant erected for this purpose. A third shipment of ore is now being prepared to bring the total to 1,200 or 1,300 tons.

★The Compañia Anomina Minas de Amianto de Tinaquillo (C.A.M.A.T.) has experienced some difficulties in the mill, and further adjustments and additional equipment are required before production of asbestos can be increased. This company has agreed to spend Bs50,000 ($15,000) on prospecting work in the region of San Pedro, State of Miranda, where some small outcrops of asbestiferous serpentine are known to exist.

★The Venezuelan Government, by special decrees, has created a reserved zone for all deposits of radioactive minerals and beryl in its territory. This followed the reported discovery of pitch-blende and beryl in the Venezuelan Andes during 1943 and 1944.

BRAZIL

Uranium ores are analyzed—Nickel deposits surveyed

★Principal Brazilian sources of uranium ore have been revealed and analyzed in a report issued by the National Laboratory of Mineral Production. The chief sources of the mineral and their location are: (1) polycrase and euxenite in Pompa, Minas Gerais; (2) samarskite in Divino de Uba and Antonio Prado, Minas Gerais; (3) uraninite in Picui (Paraiba) and Parelhas (Rio Grande do Norte).

Following is the analysis of the uranium content of the Brazilian samples:

Ore	Percent uranium
Samarskite from Uba, Minas Gerais	10.20
Fergusonite from Sabinopolis, Minas Gerais	7.79
Eschwegeite de S.J. da Lagoa, Minas Gerais	1.72
Anerodite from Espirito Santo	16.90
Polycrase from Pomba, Minas Gerais	4.36
Blomstrandine from Pomba, Minas Gerais	4.50
Pitchblende from Parelhas, Rio Grande do Norte	60.00

★Recent Brazilian Government mining

surveys have provided more accurate data on the nickel reserves in the Mantiqueira region of northern Goiaz. Examination of an area 36 square miles in the Mantiqueira district revealed 45 deposits, most of them containing large amounts of nickel-bearing garnierite. Though some of the Goiaz deposits have a metal content as high as 12 or 13 percent, the average metal content of all nickel-bearing ores in the state is 5 percent.

Next in importance to Goiaz as a nickel-producing state is Minas Gerais. Large deposits, having lower metal content than Goiaz ores, are found in Liberdale, Livramento, and Aiuruoca.

★A recent Brazilian Government decree has temporarily suspended regulations against the export of tantalite and beryllium. Such exports were banned June 1, 1945. More than two-thirds of Brazils' total output of tantalite and beryllium is produced by a mine on the upper part of the Taboas River, near the junction of the states of Paraiba and Rio Grande de Norte. It is operated by Silveira Brazil & Cia.

BOLIVIA

Tin Committee discusses contract negotiations — Mineral production for 1945 is reported

★The Bolivian Tin Committee, consisting of representatives of the Government and producers, have been meeting in La Paz during recent months to discuss the terms to be proposed to North American buyers in Washington for the renewal of the agreement of purchase and sale of Bolivian tin. The present contract ends on June 30, 1946.

It is felt that present circumstances strengthens the position of Bolivian tin in the world market. There is a considerable shortage of reserves in the face of an increasing demand. It is also known that the Far East sources of tin will not reach full production for many months.

The main objectives of the Bolivian negotiators in Washington will probably be: a price of 66c per pound, with no deductions for soluble tin and the present smelting schedule, which implies a 1½c compensation for the penalty for impurities; and a long-term contract, to cover at least the period ending on June 30, 1947, and, retroactivity, new conditions to Jan. 1, 1946.

★The expropriation of the Santa Fe mine, decreed by Government, has been revoked. The Bolivian industry protested that the expropriation decree was unjust and seriously endangered the principles of private property ownership and enterprise. The mine was returned to its owner, Sr. Gustavo Eikenberg.

★Bolivian ore and concentrate exports for 1945, which are equivalent to those

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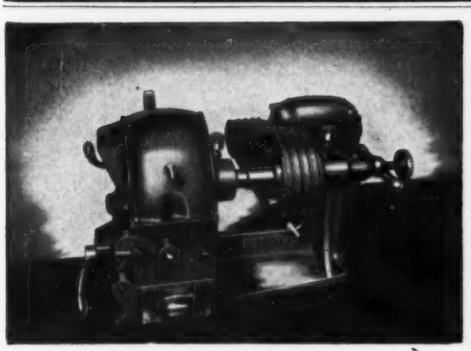

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Bolivia *(continued)*

of production because all the output is exported, are as follows:

	Kilos
Tin	43,168,686
Antimony	5,535,359
Tungsten	2,310,877
Copper	6,096,975
Lead	9,508,250
Silver	207,882
Gold	98
Zinc	20,975,637
Asbestos	61,055
Bismuth	15,337
Sulphur	617,000

Total value of mineral exports was U. S. $73,903,579.

AFRICA

Gold-mining company registers in Free State—Rand groups report ore reserves

★St. Helena Gold Mines, Ltd., is the first gold mining company to register in the Free State. The new company is an offshoot of Western Holdings, Ltd., which was organized nine years ago to investigate mining possibilities in the Free State. Authorized capital is £4,000,000, but more recent opinion suggests that the capital structure would be about £2,500,000 in 5,000,000 shares at 10s.

Names of directors of the new company indicate that Anglo American, New Consolidated Gold Fields, and Corner House will have administrative and technical control.

The St. Helena area covers 8,237 claims, of which 4,820 claims are possibly underlaid by reef. Estimating a dip of 28 deg. with an assumed width of 45 in., the possible gross tonnage of the two reefs is 201,000,000 tons. The most spectacular of all the boreholes was S.H. 7, which at a depth of 1,143 ft. intersected basal reef with an assay value equal to 1,879 in. dwt. The total claim area is more than double that of Blyvoor on the Far West Rand.

★A review of returns of gold-mining companies indicates that average working costs have risen from 18s. 11d. per ton in 1937 to 23s.9d. in 1945. Abolition of the gold realization charge, which amounted to about 8d. per ton milled, was of some benefit to the industry.

★During the last quarter of 1945 sinking of the No. 1 shaft of West Driefontein was stopped at 63 ft. to permit erection of sinking equipment. Installation of a compressor plant at No. 2 shaft and preparation of ground for surface buildings were well under way.

★The ore reserve of West Rand Consolidated Mines, re-estimated at Dec. 31, 1945, amounted to 8,741,000 tons, having an average value of 4.2 dwt. over a stoping width of 47 in. Of the total tonnage 7,172,000 tons are in the Main and Kimberly Reef series, 658,000 tons in the Bird Reef, 379,000 tons in the Livingstone Reef, and 532,000 tons in shaft and safety pillars, not available for stoping.

★The ore reserves of the New Kleinfontein Co. at Dec. 31, 1945, were estimated to be 2,547,000 tons of an average value of 4.0 dwt. over a stoping width of 48.5 in. These figures do not include 307,000 tons, averaging 4.3 dwt. over a stoping width of 54.6 in., contained in stope, shaft, and safety pillars.

★During the December quarter negotiations were concluded with Van Ryn Deep to take over 77 claims, containing the Benoi Outcrops shaft, and a further area of 78 claims containing the borehole and certain sand-filling equipment. Acquisition of the shaft will facilitate reclaiming the No. 5 shaft area at New Kleinfontein. It will also facilitate the exploitation of the area west of No. 6 shaft while the sand filling borehole will assist in the removal of pillars in the Apex Section and the subsequent extraction of any payable upper leaders.

★Rhokana Corporation reports for year ended June 30, 1945, that output of blister and electrolytic copper of the group in six years totaled 638,294 short tons, while the concentrator treated 19,019,500 tons of ore averaging 3.29 percent copper. Cost of producing blister copper increased from £20 17s. 5d.

ORE RESERVES

Mine	Date of Estimate	Tons	Value Dwt.	Width Inches
Anglo-American group				
Brakpan	Dec. 31, 1944	5,020,800	4.66	44.44
	Dec. 31, 1945	4,330,300	4.83	43.69
Daggafontein	Dec. 31, 1944	7,580,000	6.43	39.54
	Dec. 31, 1945	8,543,000	6.58	38.64
East Daggafontein	Dec. 31, 1944	2,300,000	6.20	36.00
	Dec. 31, 1945	2,835,000	6.04	36.11
Springs	Dec. 31, 1944	3,358,700	4.61	43.39
	Dec. 31, 1945	2,835,600	4.57	44.09
S.A. Lands	Dec. 31, 1944	3,155,100	4.76	42.08
	Dec. 31, 1945	2,886,600	4.65	42.13
West Springs	Dec. 31, 1944	2,818,200	4.60	54.22
	Dec. 31, 1945	2,638,500	4.74	53.91
Western Reefs	Dec. 31, 1944	2,570,000	5.84	50.08
	Dec. 31, 1945	2,628,000	6.04	48.48
Union Corporation group				
East Geduld	Dec. 31, 1944	13,800,000	5.2	59
	Dec. 31, 1945	13,250,000	5.2	59
Geduld Prop. Mines	Dec. 31, 1944	7,100,000	4.0	53
	Dec. 31, 1945	6,200,000	4.0	52.5
Grootvlei Prop.	Dec. 31, 1944	9,200,000	5.1	48
	Dec. 31, 1945	10,250,000	5.1	48
Marievale Cons.	Dec. 31, 1944	2,500,000	6.1	39
	Dec. 31, 1945	2,500,000	6.0	43
Van Dyk Cons.	Dec. 31, 1944	2,100,000	4.6	41
	Dec. 31, 1945	2,000,000	4.3	44
New Consolidated Gold Fields group				
Rietfontein Cons.	Dec. 31, 1944	454,000	4.9	57.3
	Dec. 31, 1945	537,000	5.1	58.8
Robinson Deep	Dec. 31, 1944	4,821,000	4.3	55.6
	Dec. 31, 1945	4,364,000	4.3	54.6
Simmer & Jack	Dec. 31, 1944	3,677,000	4.2	49.8
	Dec. 31, 1945	3,790,000	4.2	51.9
Vlakfontein	Dec. 31, 1944	905,000	9.8	41.4
	Dec. 31, 1945	931,000	9.7	41.4
Vogelstruisbult	Dec. 31, 1944	2,603,000	5.5	39.9
	Dec. 31, 1945	2,524,000	5.3	40.3
Barnato group				
East Champ d'Or	Dec. 31, 1944	500,000	4.4	45
	Dec. 31, 1945	421,000	4.3	50
Government Areas	Dec. 31, 1944	8,360,000	4.1	67
	Dec. 31, 1945	7,990,000	3.9	67
New State Areas	Dec. 31, 1944	2,680,000	4.4	45
	Dec. 31, 1945	2,650,000	4.4	45
Randfontein Estates	Dec. 31, 1944	7,690,000	3.1	50
	Dec. 31, 1945	7,170,000	3.0	50
Witwatersrand G.M.	Dec. 31, 1944	739,000	3.0	61
	Dec. 31, 1945	657,000	3.0	61

Central Mining—Rand Mines group		Available Ore Reserves			Additional Reserves in Pillars	
Name of Company	Year Ended 31st Dec.	Tons	Average Value, Dwt.	Stoping Width, Inches	Tons	Average Value Dwt.
City Deep	1944	3,522,800	5.7	43.9	600,300	6.4
	1945	3,537,000	5.8	42.7	588 000	6.5
Crown Mines	1944	12,497,000	4.9	44.8	4,425,100	5.5
	1945	12,071,000	4.9	45.4	4,425,000	5.5
Durban Rood. Deep	1944	7,612,000	4.6	57.0	677,700	5.2
	1945	7,768,000	4.5	58.1	844,000	4.9
E.R.P.M.	1944	8,489,000	4.8	56.0	1,823,000	4.7
	1945	7,919,000	4.8	56.0	1,813,000	4.7
Geldenhuis Deep	1944	108,800	4.1	52.0	14,100	4.4
	1945	41,600	3.4	56.7	5,900	5.2
Modderfontein B.	1944	1,723,420	4.0	54.1	245,830	3.1
	1945	1,365,000	4.1	52.9	44,000	4.4
Rose Deep	1944	1,793,900	3.9	63.0	332,900	4.7
	1945	1,584,800	3.8	62.9	341,000	4.7

per long ton in 1938-39 to £38 12s. last year, and electrolytic copper from £23 0s. 11d. to £36 1s. 6d. per ton, both f.o.b. Beira. Ore reserves are sufficient for 34 years' production at the 1944-45 rate, when 107,597 tons of copper were produced.

★The old Iron Crown mine, in the Haenertsburg district, is again in operation. It is expected that approximately 2,000 tons will be milled per month in plants now being erected. A Johannesburg company began mining operations early this year.

★The Witwatersrand district produced 996,175 oz. of gold during January, 1946, valued at £8,579,557; other districts produced a total of 20,283 oz., valued at £174,687. Native labor employment for January was 326,289, an increase of 6,853 over the December, 1945, total. This includes 27,533 colliery natives.

AUSTRALIA

New 20-ft. circular shafts planned for North Broken Hill—Mount Lyell to increase open-pit production

NEW SOUTH WALES

★New Broken Hill Consolidated, Ltd., intends to carry out extensive development in the mine at Broken Hill, and to increase ore extraction. The leases adjoin those of Zinc Corporation, Ltd., on the south, and the lead and zinc lodes worked by the latter corporation pitch into the New Broken Hill property, becoming of economic importance below 1,000 ft. from surface. Development has been carried out from the Zinc Corporation main shaft. The latter company will treat New Broken Hill ore in its mill. Broken Hill lode pitches to the north in the property of North Broken Hill, Ltd., and there is a corresponding pitch to the south at the other end of the field. The New Broken Hill Consolidated company was formed to exploit the lode at depth to the south of the Zinc Corporation mine. Work so far has shown a penetration of the lodes south from the northern boundary of over 1,000 ft., with widths and values approximating those in the Zinc Corporation mine. Ore reserves are estimated at 10,000,000 tons.

Continuation of the orebody at minable depths for a distance of 3,000 ft. south of the northern boundary is expected. Should this prove to be so, and present dimensions be maintained, the area should contain 30,000,000 tons of ore. Increased scale of operations will ultimately call for the employment of 500 men. A new shaft will be sunk on the New Broken Hill company's leases, at a point 100 ft. east of a downcast airway. The downcast airway, which is a circular, concrete-lined shaft, 13ft.6in. in diameter, is

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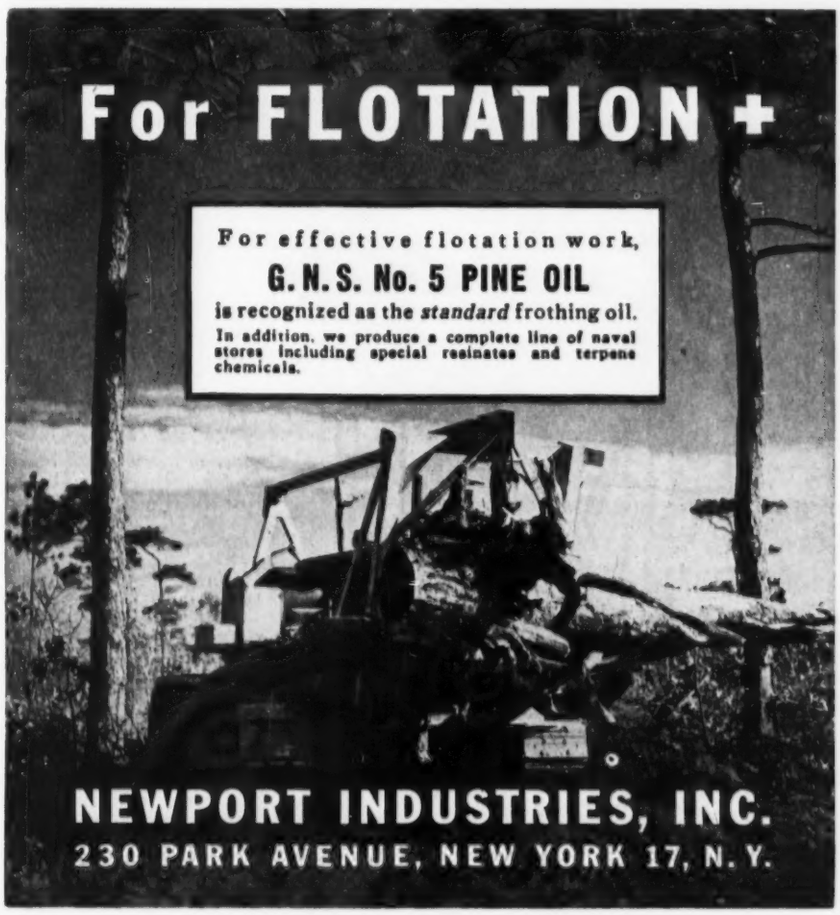
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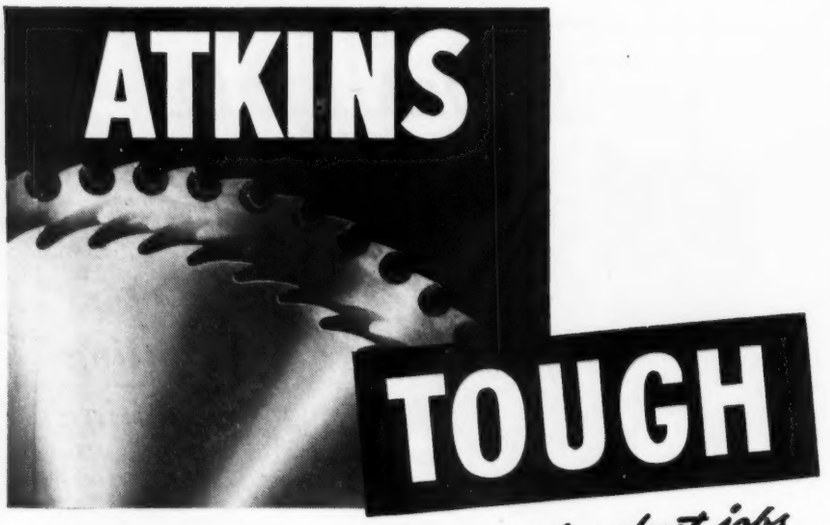

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Australia (*continued*)

1,000 ft. south of the northern boundary, and has been sunk to 2,600 ft. It will be converted into a haulage shaft and equipped with two 10-ton skips. The new shaft to be sunk will also be circular and 20 ft. in diameter; and it will be equipped with a double-deck 100-man cage, an auxiliary cage, water mains, pump columns, and an electric cable and ladder-way. Both shafts will be carried down to the 3,240-ft. level, with provisions for later extension to 5,000 ft. At a later stage, a new circular concrete-lined 20 ft. in diameter air shaft will be sunk 2,000 ft. south of the new main shaft group. These will be the first circular shafts for metal mines in Australia. The planned development will probably limit ore production in 1946 to 30,000 tons, but this will be doubled in 1947, increasing to 100,000 tons in 1948.

TASMANIA

★Electrolytic Zinc Co. of Australasia, Ltd., operates an electrolytic zinc production works at Risdon, near Hobart, treating concentrate purchased from the Broken Hill mines, and a smaller quantity produced at its own mines on the west coast of the island. Concentrates which must be shipped from the Mainland to Tasmania are roasted prior to shipment. Production during the year ended June 30, 1945, was: zinc, 80,365 tons; cadmium, 234 tons; cobalt, 12.88 tons; superphosphate, 28,941 tons.

Construction work at Risdon will increase the plant capacity to 95,000 tons of zinc per annum. The company's mines are at Rosebery and Williamsford, on the West Coast. The mill is at Rosebery, and ore from the mines at Williamsford is transported by aërial ropeway. Ore reserves in the mines are estimated at 1,500,000 tons. The ore is made up of galena, zinc blende, chalcopyrite, pyrite, and gold. It is fine-grained, requiring grinding to 90 percent minus 200 mesh. Three concentrates are made by selective flotation. Production for the year ended June 30, 1945, was as follows: zinc concentrates, 37,523 tons, assaying 55.2 per cent Zn and 2.9 per cent Pb; lead concentrate, 8,075 tons, assaying 58.6 percent Pb and 16.8 percent Zn; copper concentrate, 3,588 tons, assaying 10.5 percent Cu, 18.7 percent Zn, 17.9 percent Pb and 34.7 dwt. gold. Ore treated was 123,434 tons, assaying 19.6 percent Zn and 5.96 percent Pb. The mines employ 398 men, and 1,556 men are employed at the Risdon works. The company is investigating ways for greater utilization of the sulphur in the zinc concentrate, approximately 30 percent, for increased production of sulphuric acid for superphosphate; manufacture of sulphate of ammonia; and production of elemental sulphur. This last alternative would not be considered by itself, but would depend upon the sulphate of ammonia project.

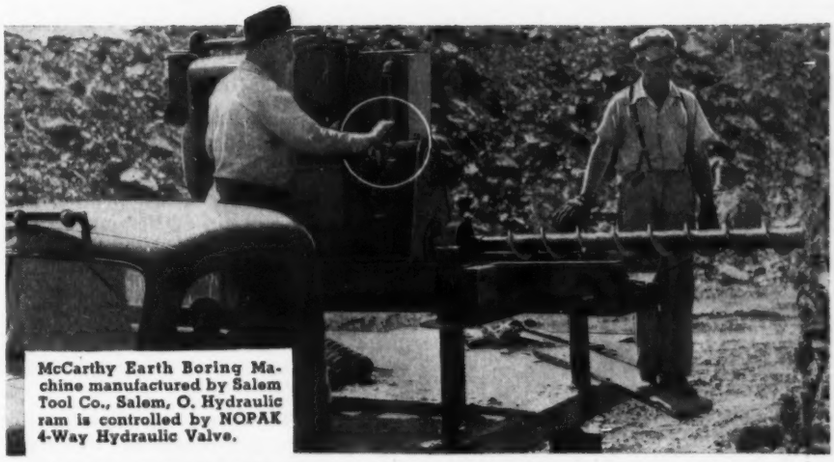
In the financial year ended Sept. 30, profit earned by Mount Lyell Mining & Railway Co., Ltd., at Queenstown, on the West Coast, fell from LA109,209 to LA4,172, mainly because of the low grade of ore treated. Shortage of labor was also a serious factor, particularly in overburden removal, and it was necessary to include some of this material in the feed sent to the mill, whereby the average assay of the open-cut ore was reduced from 0.717 percent Cu to 0.592 percent Cu. Most of the ore treated comes from the open-cut workings in the West Lyell mine, underground mining producing a relatively small tonnage. The ore is hauled by electric locomotive from a transfer pass in the North Lyell tunnel to the mill, concentrate is smelted and the blister copper electrolytically refined at the mine. Production statistics for the year ended Sept. 30, 1945, are: Ore treated 1,480,554 tons, assaying 0.666 percent Cu; blister copper produced was 7,750 tons containing 7,697 tons Cu, 26,092 oz. silver, and 5,091 oz. gold; cathode copper produced was 8,141 tons. Mine ore reserves are estimated at 36,547,000 tons, averaging 0.76 percent Cu, 0.05 oz. silver, and 0.008 oz. gold. The company intends to increase output from 4,200 to 6,000 tons per day, which will require additional mechanical equipment for the open-cut operations and the coarse-crushing and treatment sections of the plant. Open-cut workings will be carried to a depth of 290 ft. below the present lowest bench.

★More than $4,000,000 will be spent for equipment and development of the iron-ore deposits on tiny Cockatoo Island, 85 miles north of Derby, on Australia's northwest coast, Australia Iron & Steel, Ltd., has announced. The company, a subsidiary of the Broken Hill Proprietary Co. at Port Kembla, New South Wales, reports there are 30,000,000 tons of high-grade ore in sight, and estimates that it will take approximately 25 years to mine it. Production and shipment will begin in 1946.

According to the engineers, the orebody is a single bed of hard, high-grade hematite, which outcrops for a length of about 7,000 ft., and varies in width from 15 to 100 ft.

The hematite assays about 69 percent iron, and is low in manganese, phosphorus, and sulphuric content, making it suitable for admixture with iron ore from Iron Knob, South Australia. The deposit outcrops at the surface, making open-cut mining possible.

Despite the high quality of the ore, the remoteness of the tiny island, which is only 3½ miles long and 1½ miles wide, will put a considerable freight burden on the owners. Ships of 13,000 tons will come with a ballast of fresh water from New Castle, New South Wales, via Torres Strait, to be loaded with crushed ore by a conveyor belt system. The haul to the iron and steel works on the east coast of Australia is more than 2,500 miles.



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(*Continued from Page* 119)

tion, Copperopolis, Calif., died recently at Belmont, Calif., aged 37.

Ralph Woolman Deacon, a retired consulting metallurgical engineer, died at Elizabeth, N. J., on March 25.

Dr. Amadeus W. Grabau, an American geologist, dean of Peiping Laboratory of Natural History since 1925, died on March 20 at Peiping, China, at the age of 76. He was for 18 years on the faculty of Columbia University prior to his appointment as a professor at the National University at Peiping in 1920.

Edward L. Koons, an officer of several gold-mining companies and president of Sylvanite Gold Mines, Ltd., Ontario, and of its subsidiaries, Tyranite and Delnite mines, died at Buffalo, N. Y., on Feb. 24, at the age of 84.

Arthur Smith Dwight, metallurgist, inventor, and an officer in the Engineer Corps in the first World War, died at Hobe Sound, Fla., on April 1, at the age of 82. He was an alumnus of Brooklyn Polytechnic Institute, 1882, and of Columbia School of Mines, 1885.

Frank C. Ball, 67, Montana mining man, died March 4. Mr. Ball started his mining career in the Black Hills of South Dakota and spent many years operating several properties in Montana.

Joseph Oker, 84, old-time prospector and mining operator, died March 4 in Helena, Mont.

Edward Frank Kern, 73, on the staff of Columbia School of Mines for more than 40 years prior to his retirement in 1940, died at Argyle, N. Y., on Jan. 4 last.

A LETTER

No Worry Over Personnel

The Editors

In your November and December issues you have had articles discussing the relations of young men to the mining industry which disregard some well-known facts unfavorable to the future chances of those who enter this field.

A business which now advertises for men with college training plus a year or more of practical experience, at salaries of $200 to $300 per month, cannot be suffering from lack of technical men when miners and mechanics are paid $7 to $9 a day. (Refer to *E.&M.J.*, November 1945, p. 79). Either there is still an oversupply of engineers or management is not realistic about remedying the shortage, which could be most easily done by paying salaries comparable with those in other industries.

Mining in the United States has been a field of declining opportunity for young men over the past two or three decades, in spite of which fact the colleges have continued to turn out graduates many of whom were not very well fitted nor very well educated for their work. Perhaps the present alleged dearth of new men in the mining courses will have good results rather than otherwise. Consolidation of operations has been a big factor in lessening opportunity, as, for example, in the Lake Superior districts, and in Arizona copper mining. Where many mines are managed from a central office, there are of necessity fewer good jobs.

Another cause is the lack of discovery and development of new districts and new mines in old districts due to indifference of large mining companies to the necessity for exploration by drilling and other methods on the scale necessary to replace the mines which are being exhausted. Fewer mines mean fewer jobs. Still another reason for limitation of opportunity has been the overcrowding of the profession by engineers coming back from foreign countries. For example, following the Mexican revolution in 1909-1910 many engineers left the country and returned to the United States, and ultimately found jobs here. Some of those in the employ of the larger operators later returned to the Republic, but many others did not. Later there were engineers returning from Russia, and still more recently from the Philippines. Possibly it is not generally known that the Canadian Government maintains restrictions against engineers from this country, so that a special permit is required for entry on engineering business

A phase of employment which you did not mention is that in many districts in the Western states, and elsewhere in non-ferrous metal mining, the life of mines and districts may be quite short, so that jobs lack permanency. This results in the feeling expressed in the name "camp" for a western mining settlement, which is only too often shown by very poor housing and by lack of any recreational facilities other than saloons and dance halls. Instead of paying lower salaries than in other industries, the mining companies ought to pay considerably more to compensate for uncertainty of employment and poor living conditions. Your choice of a picture of the Homestake surface plant and a part of Lead, S. D. (*E.&M.J.* November 1945, p. 76) presumably as a typical "mining camp in the West," was amusing. Both mine and town are unique in American gold-mining history, both as to scale of operation and length of life. Aurora, Goldfield, or Rhyolite, in Nevada, are more typical.

An interesting figure that has not been published, so far as I know, would be the percentage of men educated in mining who are still in the business 10 years after graduation. It would be the best measure of opportunity in the industry.

These facts are not offered in a spirit of hopeless gloom and pessimism over the future of mining in the U.S.A., but they must be faced fairly

and squarely by those now responsible for the future of the industry. There is no use trying to kid the young men with glamor, nor in attracting them to mining if they have not got what it takes to stay with it.

After all, there is no use in getting steamed up about the problem. There will be competent men running mines as long as there are mines to be run, whether or not the colleges graduate any more mining engineers. There are a lot of men who would rather mine than do anything else, whether they have grown up around the mines, mills, and smelters, or have come from the farms of the Middle West or the cities of the East. There is something common to them all—maybe a larger share of the pioneering instinct than other people. They like the free and easy manners of the "camp," the excitement of seeing a freshly exposed stope face, or the interest of visiting a new country. The miner is more than a hand on the assembly line; the mine boss is more on his own from shifter to manager than in other businesses. A miner likes the smell of "underground," the chance of a good "lease," of finding that good little two-man mine with a good partner. Mining is o.k. and hard to leave once you have tried it.

J. H. FARRELL

Los Altos, Calif.

We thoroughly disagree. In our opinion the size of the slice which domestic mining cuts out of the total mining pie of the future will depend very heavily on the leadership, foresight, and courage of mining men. The industry *must* have its share of the best brains and cannot afford to sit back and take what comes. Many able young men never have any contact with mining in their formative years.

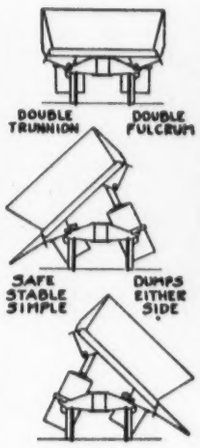
The pattern of the past has been to let the flow of ability into our industry take care of itself. As "proof of the pudding" can we claim, in comparison to other industries, that receptivity toward new ideas in our industry today is anything to brag about? We doubt it.

If consolidation means fewer jobs, this is because of shortsightedness. Consolidation should afford an opportunity to do a bigger, more efficient job by applying the knowledge of specialists.—Editor.

Limestone Replacements

(*Continued from Page* 89)

process until mixtures result that are found in our actual individual orebodies. Unfortunately, such a process would present so many apparent insurmountables that perhaps we should look elsewhere for our source of the metals and close the role of igneous rocks with the formation of the pegmatites, aplites, and allied end products, regarding whose origin there seems to be less contro-



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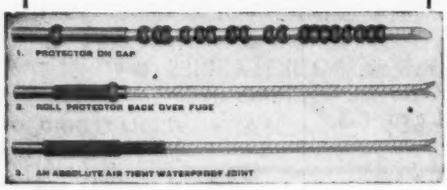

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versy, and, at the same time, give these end products credit for only such metals and ores as they may actually contain.

Suppose we do admit that our theory of ore deposition is untenable? It seems to me that we will find more ore of better grade with no premise at all than with a false one. We will have far fewer post-mortem reports filled with technical explanations of why mines played out. The operators, left to their own devices and without orthodox reasons for abandoning the mines, will probably continue them, to the benefit of all concerned.

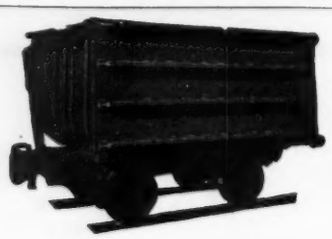
Foreign Investments

(*Continued from Page* 81)

ditions, exchange regulations, and political tendencies, and advise them on the integrity and financial standing of the property owners.

In return for such essential aid, the American mining companies should keep the local embassies or legations informed of any arrangements they may be considering and should get the approval of the ambassadors or ministers.

Before venturing into a foreign country to consider a cooperative agreement for the development or operation of a specific mine or group of mines, the interested American firm should obtain (1) reports on the mine or mineral deposit, including details on the ore occurrence, production, estimated ore reserves, and the general geology of the region; (2) descriptions of the methods of production and potential output, with estimates of cost and profit; (3) proposals for plant expansion or new plants and estimated costs; (4) information on the availability of mining machinery, mine supplies, power, and labor; (5) data on mining laws restricting foreign investment and exploitation of mines, as well as information about taxes on property, imports, exports, and profits; (6) advice on the current political stability of the government in power, possibility of a change, and risk involved; (7) statistics on domestic and foreign markets for products. Some of this information is available at the Interior and Commerce departments, as well as at the State Department, to those desiring background information before going to a foreign country. Should the representative of a mining company call upon or write to these Government agencies in Washington, he may be able to get much valuable information as to the countries he is to visit.



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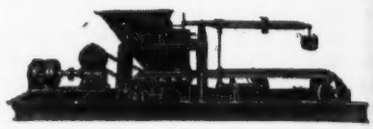

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